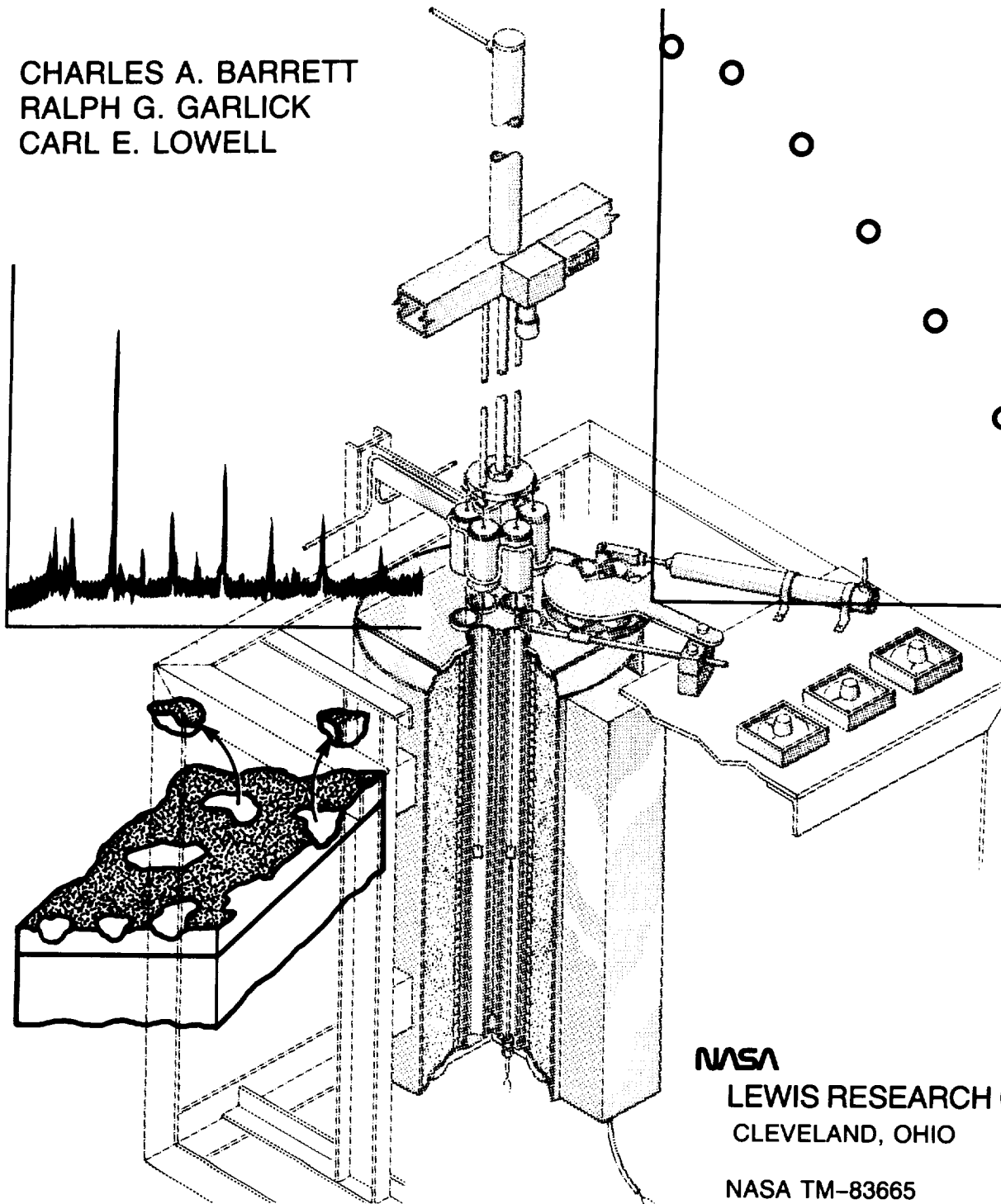


HIGH-TEMPERATURE CYCLIC OXIDATION DATA

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TURBINE ALLOYS, PART 1
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— —

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High-Temperature Cyclic Oxidation Data

Turbine Alloys, Part 1

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October 1989



National Aeronautics and
Space Administration

Lewis Research Center
Cleveland, Ohio 44135

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Summary

To make the large body of cyclic oxidation data collected at NASA Lewis Research Center widely available, Lewis is publishing a series of cyclic oxidation handbooks. This first part in that series contains specific-weight-change-versus-time data and x-ray diffraction results derived from high-temperature cyclic tests on high-temperature, high-strength nickel-base γ/γ' and cobalt-base turbine alloys. Each page of data summarizes a complete test on a given alloy sample. Part 2 of the series, which contains data for the remainder of the high-temperature, high-strength nickel-base γ/γ' and cobalt-base turbine alloys tested at Lewis, is available as NASA Technical Memorandum 101468.

Introduction

High-temperature oxidation literature is concerned mainly with isothermal testing. This has led to a large body of oxide growth and transport property data. However, most applications for high-temperature materials are cyclic. During cyclic oxidation the degree of spalling is as important in estimating total metal loss as the growth rate of the oxide is in determining metal consumption (ref. 1). Oxidation studies at Lewis Research Center have focused on cyclic testing, both furnace and burner rig. The goal of these studies is to evaluate the mechanisms of material degradation in order to formulate cyclic oxidation models for predicting life (ref. 1).

As these studies proceeded, standard testing methods were developed (refs. 1 to 6) and a large body of cyclic oxidation data was collected. Some of these data have been reported as the results of specific investigations, but most have never found their way into print. To make these data useful to as many interested members of the oxidation research community as possible, NASA Lewis is publishing a series of cyclic oxidation handbooks. This first volume contains specific-weight-change-versus-time data and available x-ray diffraction results derived from high-temperature cyclic tests on high-temperature, high-strength nickel-base γ/γ' and cobalt-base turbine alloys. Table I lists these alloys in the order in which the data are presented. The alloy composition is detailed in part 2 of this series (NASA TM-101468). The details of testing, deriving, and analyzing the data are discussed in reference 7.

Oxidation Data

The data are presented in the following manner: each page summarizes a complete test on a given alloy sample. The heading on each page gives the test conditions and the nature of the alloy. The number in the upper right corner of the page completely codes and identifies the test for computer processing. For example, with 02-04-019-115-1, 02 means nickel base; 04 means commercial cast γ/γ' alloys; and 019 designates the alloy (in this case TAZ-8A). The last four numbers (115-1) are unique and refer to the NASA Lewis test run and test position.

Under the descriptive heading the specific-weight-change-versus-time data are both plotted and listed. X-ray diffraction data are listed where available. The results are separated into surface data and spall data. The phases are given in decreasing order of intensity. If the matrix can be identified through the scale, this information is included. If the x-ray results were obtained after various times, they are listed from the shortest to the longest test times. Table II lists the sample surface conditions that might qualify the results. Because a "standard surface" was analyzed in most cases, there were no interpretive problems. The spall results also have five qualifiers (table II). The biggest problem here was in possible cross-spall—particularly from samples tested in adjacent tubes for a given run. Some of these problems are discussed in references 4 and 7.

Three major types of oxide scaling product are formed during oxidation (table III). First, there are the various discrete oxides such as the protective Al_2O_3 and Cr_2O_3 , spall inhibitors like Y_2O_3 and ZrO_2 , and minor constituent oxides including MoO_2 and CoWO_4 . Second, there is a class of solid-solution cubic oxides termed spinels. Finally, there is a rutile/tri-rutile tetragonal oxide consisting of Ti and the refractory metals Ta, Nb, W, and Mo. The 21 discrete oxides listed in the first part of table III range from the commonly found Cr_2O_3 , NiO, and Al_2O_3 to the less common CoMoO_4 .

The cubic oxides, termed spinels, are listed by their lattice parameter values in angstroms. Generally, the three lower values (8.05, 8.10, and 8.15 Å) denote aluminate spinels like NiAl_2O_4 . Spinel with values ranging from 8.25 to 8.40 Å are usually chromites like NiCr_2O_4 . Spinel with values close to 8.50 Å are usually spinels with high manganese content.

A third type of oxide has a tetragonal structure containing titanium or refractory metals and is classed as rutile/tri-rutile. This general category of oxides includes tapiolite (ref. 3) with a general composition of Ni, Fe, Co(Nb, Ta, Mo, W)O₂; rutiles such as TiO₂, TaO₂, AlTaO₄, CrTaO₄, and CrNbO₄; and tri-rutiles with a general composition of Ni, Co, Fe(Ta, Nb)O₄. These subcategories are difficult to distinguish, especially in small amounts, and here they are differentiated by the lattice spacing (i.e., d-value of the (110) plane). In addition, there may be occasional diffraction lines that cannot be associated with one of these three phases. The d-values of up to four diffraction lines can be listed in order of decreasing intensity.

The test data are presented in alloy alphabetical order, first for the nickel-base and then for the cobalt-base systems. The individual alloy data are shown from high to low temperatures and from short to long cycle times (i.e., assumed decreasing order of test severity) and the sequence from lowest to highest numbered runs.

Comments on the Data

The induction-melted cast test specimens were of several different types. They are classified as shown in table IV.

The following tests might be possible outliers since the results appeared anomalous when compared with other results for the same alloy. However, they were included because no reason could be found to reject them.

- (1) Run 336-4 on page 49 for B-1900 at 1100 °C
- (2) Run 324-4 on page 99 for MAR-M-211 at 1100 °C
- (3) Run 078-3 on page 105 for NASA-TRW-VI-A at 1150 °C

The TAZ-8A alloy results fall into two groupings. The first grouping represents experimental heats, whereas the data on pages 136 and 140 were for samples from a remelted commercial ingot.

The variability in the IN-100 alloy results has been discussed previously in reference 6.

References

1. Barrett, C.A.; and Evans, E.B.: Cyclic Oxidation Evaluation—Approaching Application Conditions. NASA TM X-68252, 1973.
2. Spera, D.A.; and Grisaffe, S.J.: Life Prediction of Turbine Components: On-Going Studies at Lewis Research Center. NASA TM X-2664, 1973.
3. Barrett, C.A.; Santoro, G.J.; and Lowell, C.E.: Isothermal and Cyclic Oxidation at 1000 and 1100 °C of Four Nickel-Base Alloys: NASA-TRW-VI, B-1900, 713C, and 738X. NASA TN D-7484, 1973.
4. Barrett, C.A.; and Lowell, C.E.: Comparison of Isothermal and Cyclic Oxidation Behavior of Twenty-Five Commercial Sheet Alloys at 1150 °C. *Oxid. Met.*, vol. 9, no. 4, Aug. 1975, pp. 307-355.
5. Barrett, C.A.: 10 000-Hour Cyclic Oxidation Behavior at 815 °C (1500 °F) of 33 High-Temperature Alloys. *Environmental Degradation of Engineering Materials*, M.R. Louthan, Jr., and R.P. McNitt, eds., Virginia Polytechnic Institute and State University, Blacksburg, VA., 1978, pp. 319-327.
6. Barrett, C.A.; Johnston, J.R.; and Sanders, W.A.: Static and Dynamic Cyclic Oxidation of 12 Nickel-, Cobalt-, and Iron-Base High-Temperature Alloys. *Oxid. Met.*, vol. 12, no. 4, Aug. 1978, pp. 343-377.
7. Barrett, C.A.; and Lowell, C.E.: High Temperature Cyclic Oxidation Furnace Testing at NASA Lewis Research Center. *Journal of Testing and Evaluation*, JTEVA, vol. 10, no. 6, Nov. 1982, pp. 273-278. (Also NASA TM-81773.)

TABLE I.—TEST ALLOYS

Code	Alloy	Code	Alloy
Nickel-base, cast γ/γ'		Nickel-base, hot-worked γ/γ'	
02-04-01	B-1900	02-13-01	Alloy 625
02	B-1900 + Hf	02	Alloy 718
40	DS IN-100	03	Astroloy
10	DS MAR-M-200 + Hf	04	Nimonic 115
39	DS NX-188	05	R-235
42	DS TAZ-8A	06	René 41
41	DS WAZ-20	07	René 77
03	IN-100	08	U-500
04	IN-713C	09	U-520
05	IN-738	10	U-700
06	IN-792	38	U-700(PM/HIP)
07	IN-792 + Hf	11	U-710
31	IN-939	12	U-720
08	MAR-M-200	13	Waspaloy
09	MAR-M-200 + Hf	Cobalt-base, cast (turbine) alloys	
11	MAR-M-211	03-02-03	MAR-M-509
12	MAR-M-246	02	WI-52
26	MAR-M-247	01	X-40
13	MAR-M-421		
21	NASA-TRW-VI-A		
27	NX-188		
15	René 77		
25	René 80		
16	René 120		
17	René 125		
19	TAZ-8A		
20	TRW-1910		
32	TRW-R		
43	U-700		
24	WAZ-20		

TABLE II.—NATURE OF X-RAY
DIFFRACTION RESULTS

Specimen surface	Scale spall
Standard normal surface	Collected spall
Surface distorted	Probable cross-spall
Sample consumed	No spall observed
Sample lost in furnace	Spall lost
Surface growth	No spall available
Selected areas	
Poor surface (round and flexed)	
Scraped	
Second surface phase	

TABLE III.—OBSERVED OXIDES FORMED IN CYCLIC OXIDATION OF Fe-Ni-, AND Co-BASE ALLOYS AT HIGH TEMPERATURES AS DETERMINED BY X-RAY DIFFRACTION

Type	Composition	Comments
Oxide	Cr ₂ O ₃	Protective
	Al ₂ O ₃	Protective
	Fe ₂ O ₃	Nonprotective
	NiO	
	CoO	
	(Ni,Co)O	↓
	Y ₂ O ₃	Spall inhibitor
	ZrO ₂	Spall inhibitor
	SiO ₂	Spall inhibitor
	ThO ₂	Spall inhibitor
	HfO ₂	Spall inhibitor
	Mn ₂ O ₃	-----
	MoO ₂	-----
	Ni(W, Mo)O ₄	JCPDS-15-755 or 16-291
	Ni(W, Mo)O ₄	JCPDS-18-879
	CoMoO ₄	JCPDS-25-1434
	CoMoO ₄	JCPDS-21-868
	CoWO ₄	JCPDS-15-867
	3Y ₂ O ₃ -5Al ₂ O ₃	JCPDS-8-178
	3Y ₂ O ₃ -5Al ₂ O ₃	JCPDS-9-310
	(Ni, Co, Fe)TiO ₃	JCPDS-17-617 or 15-866 or 29-733
	Cr _{0.12} Ti _{0.78} O _{1.74}	-----
	Al ₂ TiO ₅	-----
	Al(Ta, Cb)O ₄	-----
	(Ni, Co)TiO ₃	JCPDS 17-617, 15-866
Oxide spinels	MeM ₂ O ₄ (cubic) denoted by lattice parameter, a_0 :	Where Me is Fe, Ni, or Co and M is Fe, Cr, Al, or Mn
	8.05, 8.10, 8.15 Å—Aluminate spinels 8.20 to 8.40 Å—Chromite spinels 8.45 to 8.50 Å Manganate spinels	
Rutile/tri-rutile	Tetragonal denoted by lattice spacing, d , on (110):	Where refractory metal is Ta, Cb, W, Mo
	3.25 to 3.27 Å—TiO ₂ 3.27 to 3.34 Å—Cr (refractory metal)O ₄ 3.34 to 3.36 Å—Ni, Fe, Co (refractory metal) ₂ O ₆ or TaO ₂	

TABLE IV.—INDUCTION-MELTED CAST TEST SPECIMEN TYPES

Specimen type		Run-position number	Specimen type		Run-position number
Master ingot recast as 4- by 1- by 0.25-in.-thick bars, heat treated and sectioned into four 1- by 1- by 0.25-in.-thick samples with a 0.125-in.-diam hanger hole, with all sides ground to remove 0.01 in., all sides glass bead blasted		001-1 to 001-6 002-1 to 002-6 003-1 to 003-6 004-1 to 004-6 005-1 to 005-6 006-1 to 006-6 007-1 to 007-6 008-1 to 008-6 009-1 to 009-6 010-1 to 010-6 041-1 to 041-4 078-1, 078-2 078-3, 078-6 130-4, 130-5 221-5	Master ingot recast as 1- by 2- by 0.100-in.-thick leafs cut to 0.4 to 0.5 by 0.9 in. long with 0.125-in.-diam hanger hole	As-cast thickness	99-1, 99-2 101-3 to 101-6 102-1 to 102-6 105-1 to 105-6 107-4, 107-5 115-3, 115-6 127-3, 127-4 139-1 to 139-6 190-6 204-5 221-1
				Ground to 0.090-in. thickness	123-1, 123-2, 123-5 129-3, 129-4, 129-6 130-3, 130-6 186-6 190-4, 190-5 204-3, 204-4 225-1 to 225-6 231-5 238-5 276-1 310-1 to 310-5 321-1 to 321-6 322-1 to 322-4 323-2 to 323-5 324-1 to 324-6 325-1 to 325-4 326-2 to 326-5 327-1, 327-3 328-1, 328-3 336-4, 336-5 337-4, 337-5
Master ingot recast standard Mach 0.3 burner rig bar with shank 2-in.-long teardrop cross section, 0.5 in. across	2-in.-long cross section removed from shank with 0.125-in.-diam hanger hole	127-1, 127-2			
	2-in.-long section, cut into 0.125-in.-thick samples with 0.125-in.-diam hanger hole	095-1 to 095-6 096-1 to 096-6 098-1 to 098-6 104-1, 104-2 120-1, 120-2 127-5, 127-6 128-1 to 128-6 131-4, 131-5 140-4, 140-5 146-3, 146-5 151-1, 151-2			
Master ingot heat-cast into small ingots and machined into samples 0.4 to 0.5 by 0.9 in. long with 0.125-in.-diam hanger hole, ground to 0.090-in. thickness		041-6 108-3 to 108-6 232-3, 232-6	Master ingot recast as 2-in.-long by 0.240-in.-diam. tensile samples, heat treated, with 0.125-in.-diam hanger hole		103-1 to 103-7

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-041-1

B-1900

1150°C

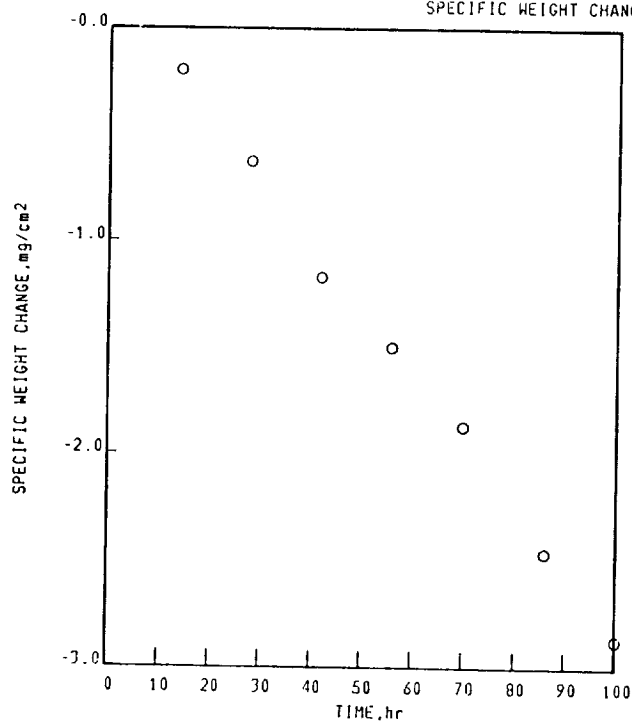
1.00hr CYCLES

100.00hr TEST

6.500mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
14.00	-0.20
28.00	-0.63
42.00	-1.18
56.00	-1.50
70.00	-1.87
86.00	-2.47
100.00	-2.87

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-041-1

B-1900

1150°C

1.00hr CYCLES

100.00hr TEST

6.500mm THICK

STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

100 hr

STANDARD SURFACE

SPINEL, $a_0=8.10\text{\AA}$.

UNKNOWN LINES, d VALUES

2.57Å.

3.29Å.

3.52Å.

FACE CENTERED CUBIC MATRIX

SPALL

100 hr

COLLECTED SPALL

NiO

SPINEL, $a_0=8.20\text{\AA}$.

Cr₂O₃

UNKNOWN LINES, d VALUES

3.26Å.

Ni BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-078-2

B-1900

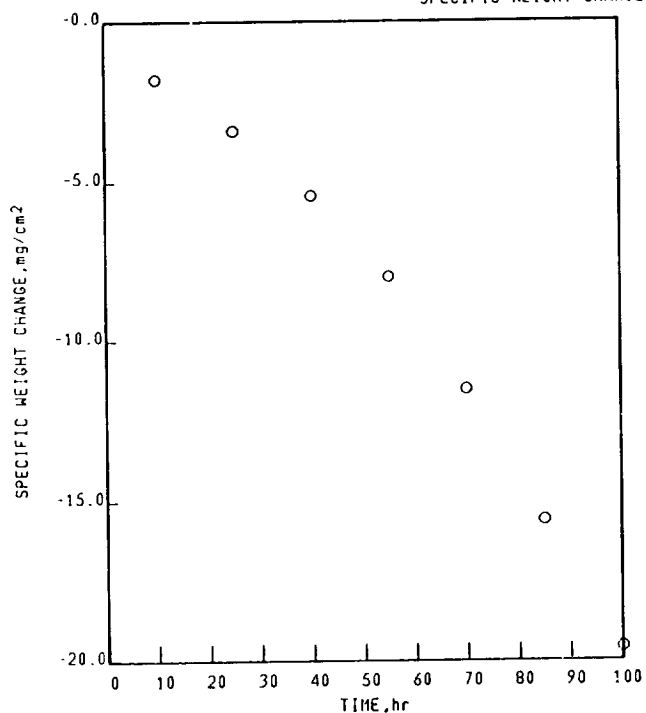
1150°C

1.00hr CYCLES

100.00hr TEST 6.480mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	$\Delta W/A, \text{mg/cm}^2$
0.00	0.00
10.00	-1.82
25.00	-3.43
40.00	-5.45
55.00	-8.00
70.00	-11.54
85.00	-15.60
100.00	-19.59

Ni BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-078-2

B-1900

1150°C

1.00hr CYCLES

100.00hr TEST 6.480mm THICK

STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

100 hr

STANDARD SURFACE

TRI(RUTILE), $d(110) \leq 3.30\text{\AA}$.

SPINEL, $a_0 = 8.10\text{\AA}$.

NiO

Al₂O₃

FACE CENTERED CUBIC MATRIX

SPALL

100 hr

COLLECTED SPALL

NiO

TRI(RUTILE), $d(110) \leq 3.30\text{\AA}$.

TRI(RUTILE), $d(110) \leq 3.30\text{\AA}$.

Al₂O₃

Ni BASE

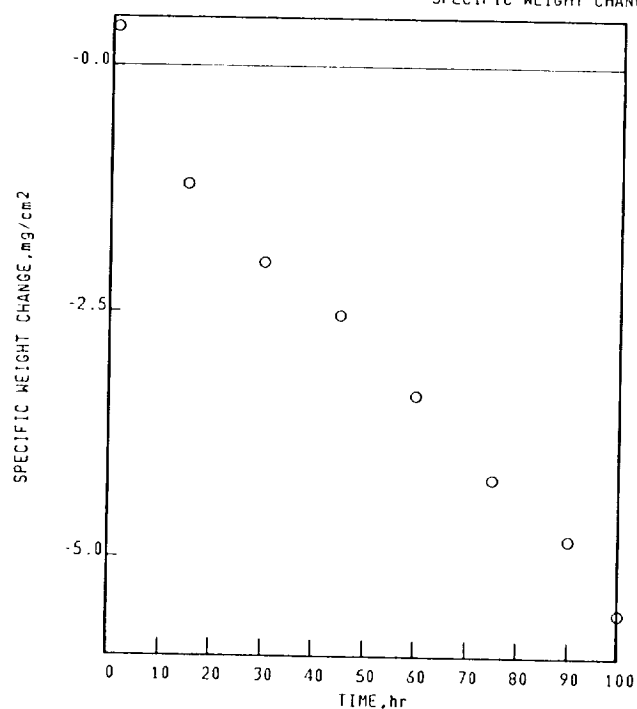
COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-095-1

B-1900

1150°C 1.00hr CYCLES 100.00hr TEST 3.218mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	$\Delta W/A, \text{mg/cm}^2$
0.00	0.00
1.00	0.39
15.00	-1.21
30.00	-1.99
45.00	-2.53
60.00	-3.35
75.00	-4.20
90.00	-4.81
100.00	-5.56

Ni BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-095-1

B-1900

1150°C 1.00hr CYCLES 100.00hr TEST 3.218mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE
100 hr
STANDARD SURFACE
SPINEL, $a_0=8.15\text{\AA}$.
NiO
FACE CENTERED CUBIC MATRIX

SPALL
100 hr
COLLECTED SPALL
NiO
SPINEL, $a_0=8.25\text{\AA}$.
SPINEL, $a_0=8.15\text{\AA}$.

NI BASE

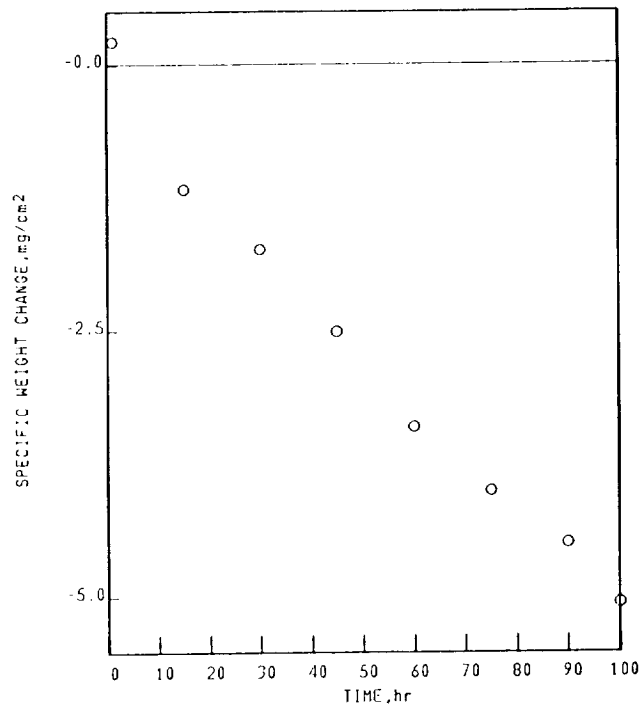
COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-095-2

B-1900

1150°C 1.00hr CYCLES 100.00hr TEST 3.253mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	$\Delta W/A, \text{mg/cm}^2$
0.00	0.00
1.00	0.21
15.00	-1.17
30.00	-1.73
45.00	-2.51
60.00	-3.39
75.00	-3.99
90.00	-4.49
100.00	-5.05

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-101-3

B-1900

1150°C

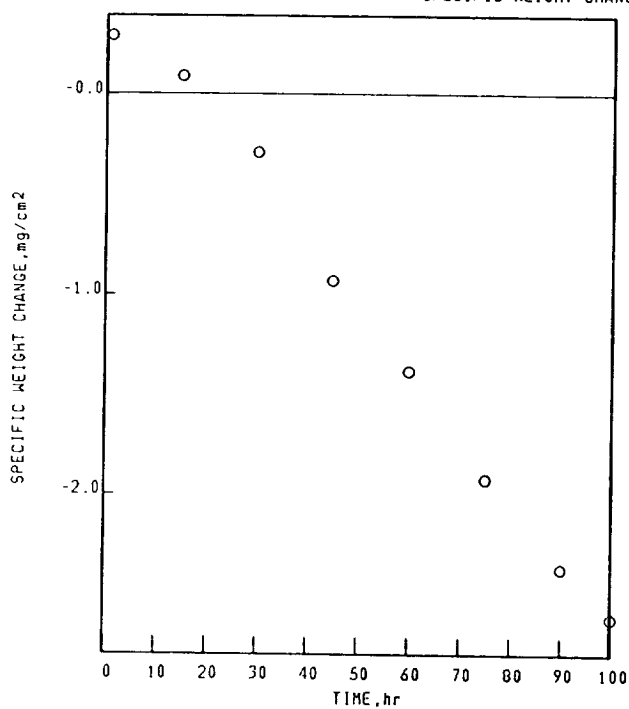
1.00hr CYCLES

100.00hr TEST

2.732mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.29
15.00	0.09
30.00	-0.29
45.00	-0.93
60.00	-1.39
75.00	-1.92
90.00	-2.37
100.00	-2.62

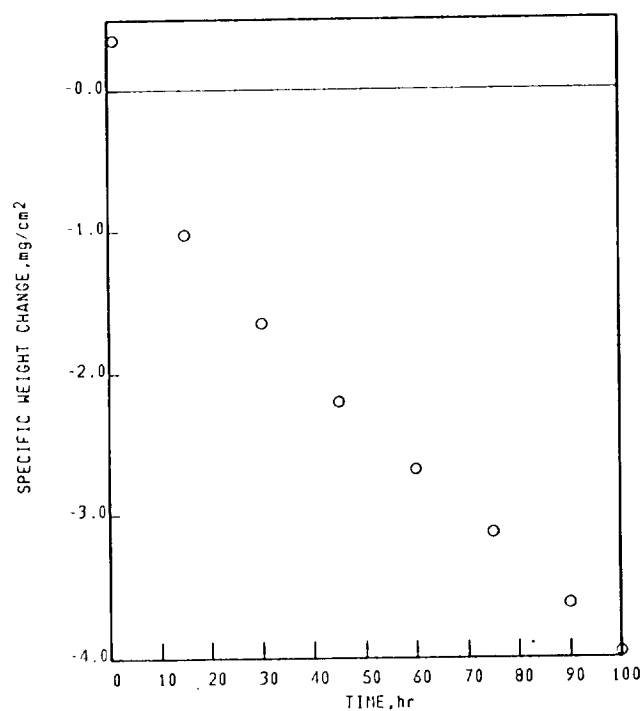
NI BASE
B-1900

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-101-6

1150°C 1.00hr CYCLES 100.00hr TEST 2.738mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.35
15.00	-1.03
30.00	-1.65
45.00	-2.20
60.00	-2.69
75.00	-3.13
90.00	-3.62
100.00	-3.97

NI BASE
B-1900

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-101-6

1150°C 1.00hr CYCLES 100.00hr TEST 2.738mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE
100 hr
STANDARD SURFACE
NiO
Al₂O₃
TRT(RUTILE), d(110) < 3.30Å.
SPINEL, a₀ = 8.10Å.

FACE CENTERED CUBIC MATRIX

SPALL
100 hr
COLLECTED SPALL
Cr₂O₃
SPINEL, a₀ = 8.35Å.

Ni BASE

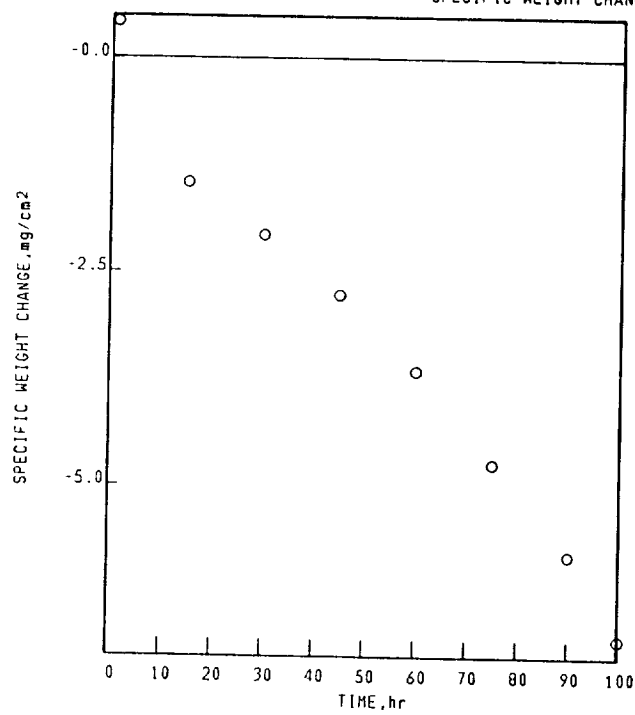
COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-107-4

B-1900

1150°C 1.00hr CYCLES 100.00hr TEST 2.741mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.42
15.00	-1.45
30.00	-2.06
45.00	-2.77
60.00	-3.67
75.00	-4.73
90.00	-5.80
100.00	-6.80

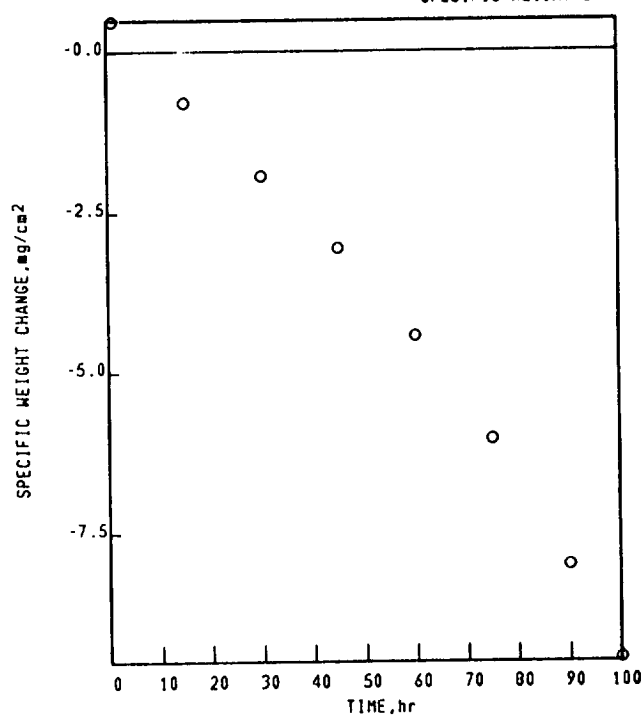
NI BASE
B-1900

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-107-5

1150°C 1.00hr CYCLES 100.00hr TEST 2.710mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.47
15.00	-0.79
30.00	-1.92
45.00	-3.06
60.00	-4.43
75.00	-6.03
90.00	-8.00
100.00	-9.45

NI BASE
B-1900

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-107-5

1150°C 1.00hr CYCLES 100.00hr TEST 2.710mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE
100 hr
STANDARD SURFACE
TRI(RUTILE), $d(110) \leq 3.30\text{\AA}$.
 Al_2O_3
SPINEL, $a_0 = 8.15\text{\AA}$.
NiO

SPALL
100 hr
COLLECTED SPALL
NiO
TRI(RUTILE), $d(110) \leq 3.30\text{\AA}$.
TRI(RUTILE), $d(110) \leq 3.30\text{\AA}$.
SPINEL, $a_0 = 8.10\text{\AA}$.

FACE CENTERED CUBIC MATRIX

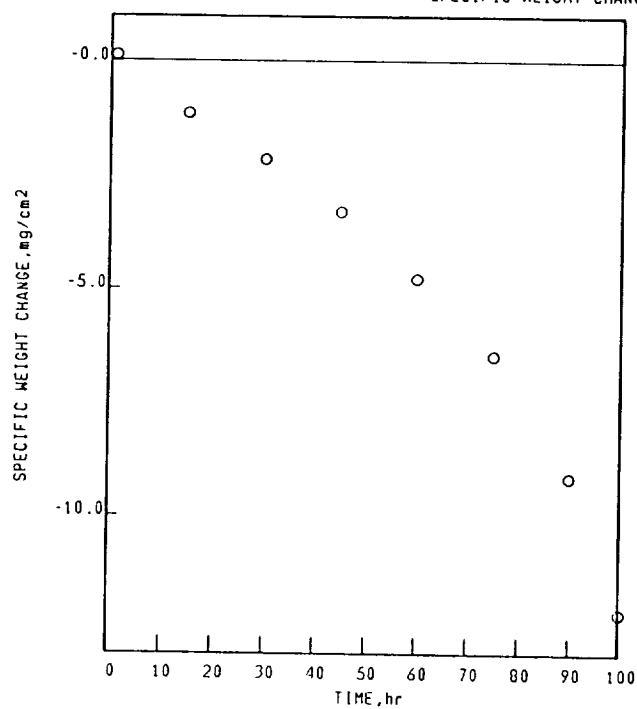
Ni BASE
B-1900

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-123-1

1150°C 1.00hr CYCLES 100.00hr TEST 2.283mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	$\Delta W/A, \text{mg/cm}^2$
0.00	0.00
1.00	0.11
15.00	-1.17
30.00	-2.18
45.00	-3.34
60.00	-4.78
75.00	-6.48
90.00	-9.15
100.00	-12.11

NI BASE

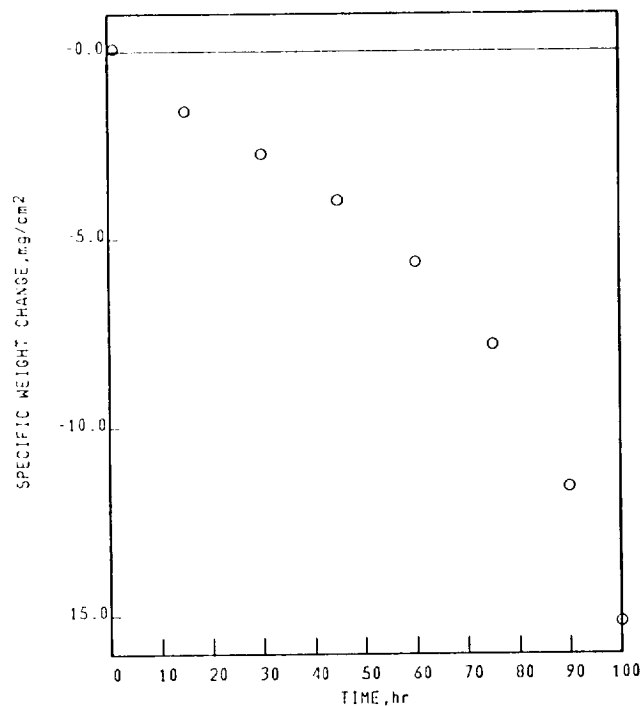
COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-123-2

B-1900

1150°C 1.00hr CYCLES 100.00hr TEST 2.285mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.07
15.00	-1.59
30.00	-2.73
45.00	-3.98
60.00	-5.63
75.00	-7.80
90.00	-11.59
100.00	-15.16

Ni BASE

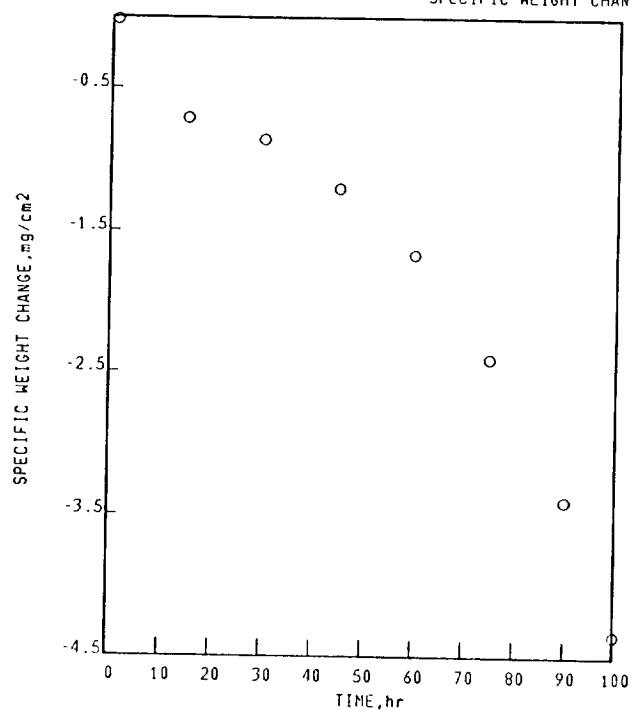
COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-123-4

B-1900

1150°C 1.00hr CYCLES 100.00hr TEST 1.142mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	-0.02
15.00	-0.72
30.00	-0.87
45.00	-1.20
60.00	-1.67
75.00	-2.41
90.00	-3.40
100.00	-4.35

Ni BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-123-4

B-1900

1150°C 1.00hr CYCLES 100.00hr TEST 1.142mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE
100 hr
STANDARD SURFACE
SPINEL, $a_0=8.10\text{\AA}$.
 Al_2O_3
TRI(RUTILE), $d(110)\leq 3.30\text{\AA}$.
SPINEL, $a_0=8.25\text{\AA}$.
FACE CENTERED CUBIC MATRIX

SPALL
100 hr
NO SIGNIFICANT SPALL OBSERVED

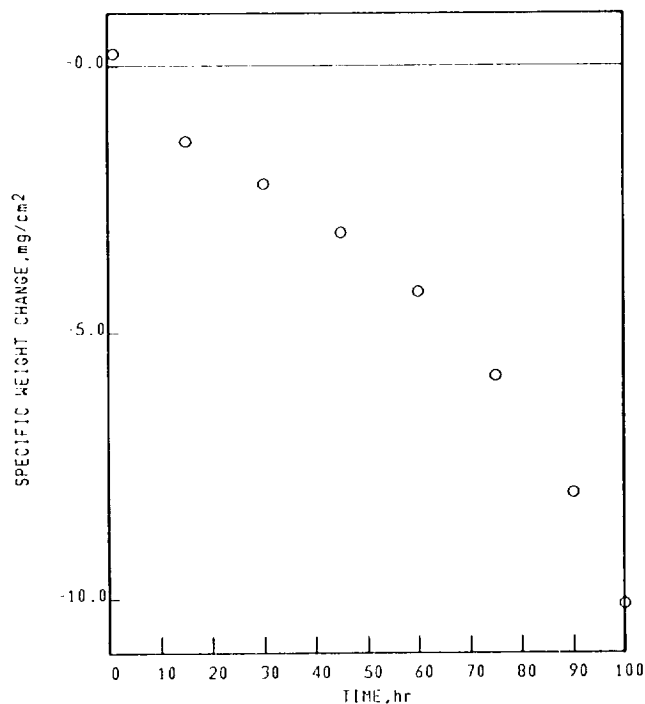
Ni BASE
B-1900

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-123-5

1150°C 1.00hr CYCLES 100.00hr TEST 2.288mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.23
15.00	-1.43
30.00	-2.22
45.00	-3.14
60.00	-4.24
75.00	-5.62
90.00	-8.02
100.00	-10.10

Ni BASE
B-1900

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-123-5

1150°C 1.00hr CYCLES 100.00hr TEST 2.288mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE
100 hr
STANDARD SURFACE
SPINEL, $a_0=8.10\text{\AA}$.
 Al_2O_3
 $\text{Ti}(\text{RUTILE})$, $d(110)\leq 3.30\text{\AA}$.
 NiO
SPINEL, $a_0=8.25\text{\AA}$.
 Cr_2O_3

SPALL
100 hr
COLLECTED SPALL
 NiO
 $\text{Ti}(\text{RUTILE})$, $d(110)\leq 3.30\text{\AA}$.
SPINEL, $a_0=8.30\text{\AA}$.
SPINEL, $a_0=8.05\text{\AA}$.

FACE CENTERED CUBIC MATRIX

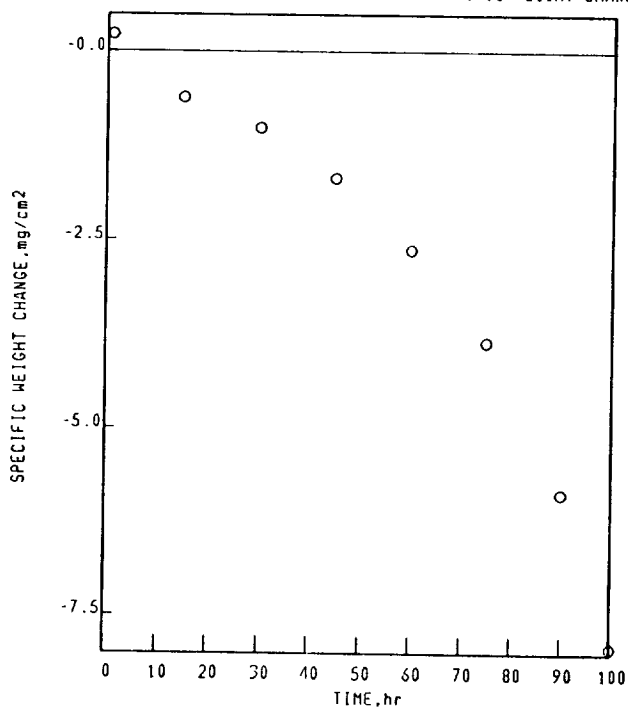
Ni BASE
B-1900

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-123-6

1150°C 1.00hr CYCLES 100.00hr TEST 1.141mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME,hr	ΔW/A,mg/cm²
0.00	0.00
1.00	0.22
15.00	-0.60
30.00	-1.00
45.00	-1.67
60.00	-2.64
75.00	-3.86
90.00	-5.87
100.00	-7.93

Ni BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-128-1

B-1900

1150°C

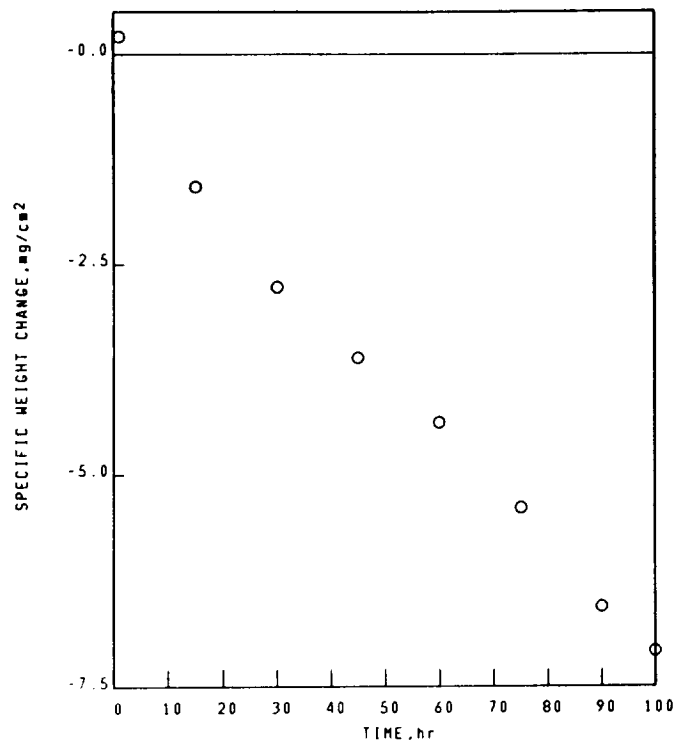
1.00hr CYCLES

100.00hr TEST

3.302mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.21
15.00	-1.58
30.00	-2.77
45.00	-3.61
60.00	-4.38
75.00	-5.40
90.00	-6.55
100.00	-7.08

NI BASE

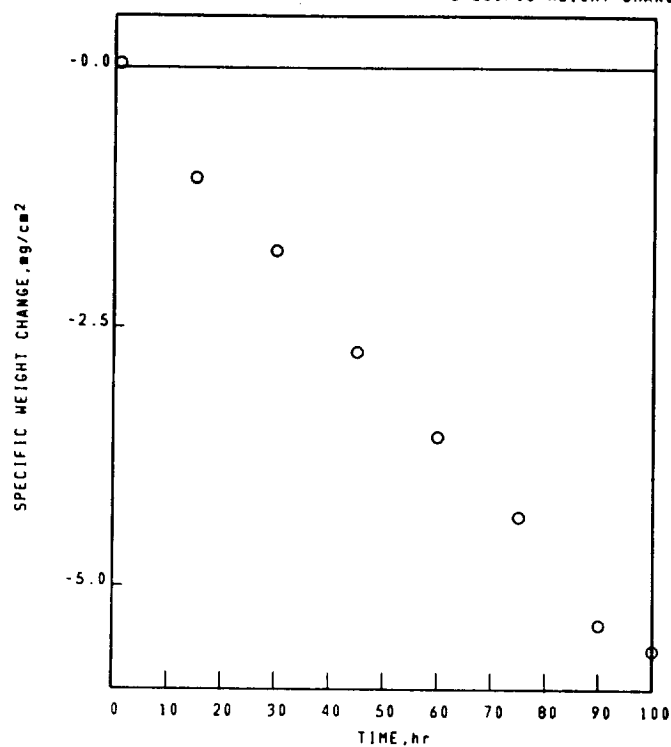
COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-128-2

B-1900

1150°C 1.00hr CYCLES 100.00hr TEST 3.302mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.04
15.00	-1.05
30.00	-1.76
45.00	-2.74
60.00	-3.55
75.00	-4.32
90.00	-5.38
100.00	-5.62

Ni BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-130-1

D-1900

1150°C

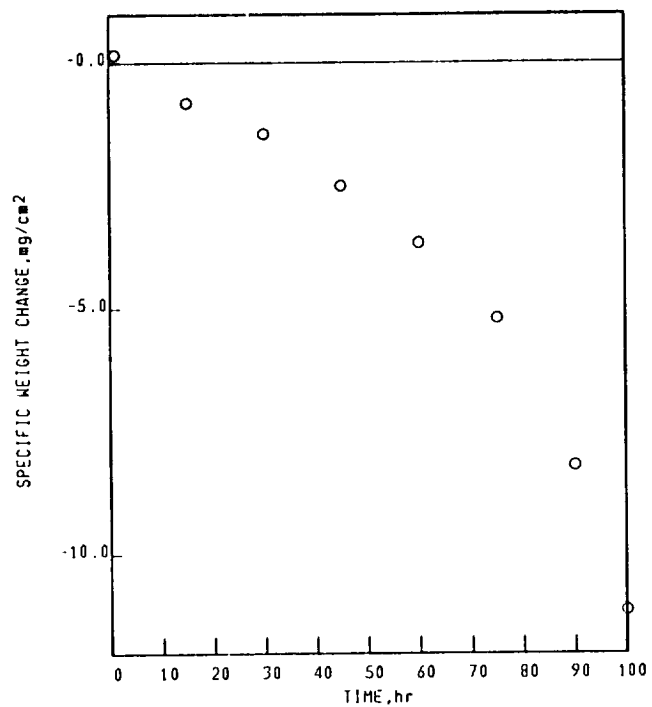
1.00hr CYCLES

100.00hr TEST

1.140mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.16
15.00	-0.02
30.00	-1.46
45.00	-2.52
60.00	-3.67
75.00	-5.20
90.00	-8.22
100.00	-11.14

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-130-2

B-1900

1150°C

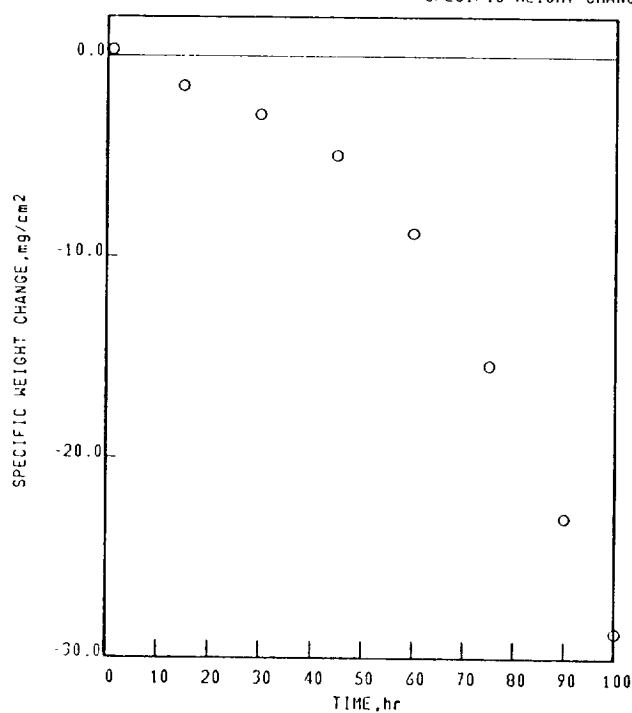
1.00hr CYCLES

100.00hr TEST

1.140mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.30
15.00	-1.45
30.00	-2.86
45.00	-4.90
60.00	-8.83
75.00	-15.40
90.00	-23.01
100.00	-28.76

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-130-2

B-1900

1150°C

1.00hr CYCLES

100.00hr TEST

1.140mm THICK

STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

100 hr

STANDARD SURFACE

SPINEL, $a_0=8.10\text{\AA}$.

SPINEL, $a_0=8.25\text{\AA}$.

NiO

TRI(RUTILE), $d(110)\leq 3.30\text{\AA}$.

FACE CENTERED CUBIC MATRIX

SPALL

100 hr

COLLECTED SPALL

NiO

TRI(RUTILE), $d(110)\leq 3.30\text{\AA}$.

SPINEL, $a_0=8.05\text{\AA}$.

SPINEL, $a_0=8.25\text{\AA}$.

ZrO₂

Ni BASE

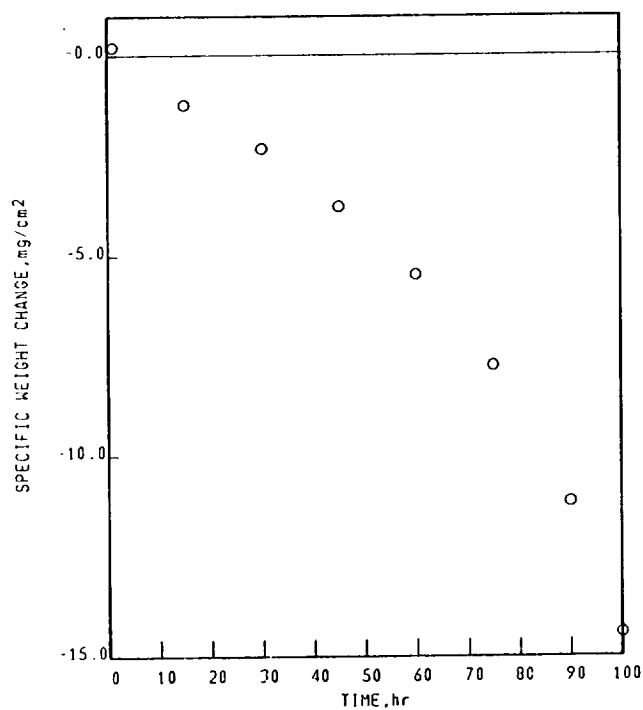
COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-130-3

B-1900

1150°C 1.00hr CYCLES 100.00hr TEST 2.285mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.21
15.00	-1.25
30.00	-2.34
45.00	-3.76
60.00	-5.48
75.00	-7.76
90.00	-11.14
100.00	-14.43

NI BASE

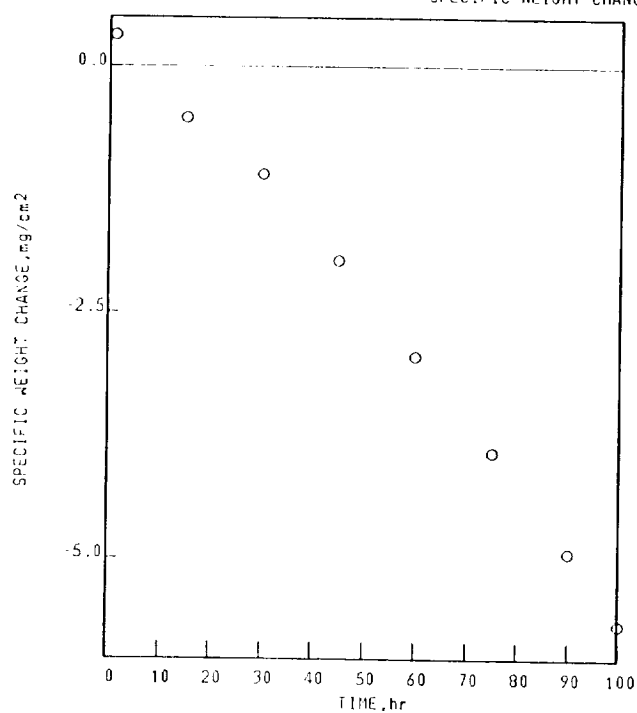
COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-130-4

B 1900

1150°C 1.00hr CYCLES 100.00hr TEST 6.505mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.31
15.00	-0.52
30.00	-1.10
45.00	-1.98
60.00	-2.94
75.00	-3.91
90.00	-4.93
100.00	-5.66

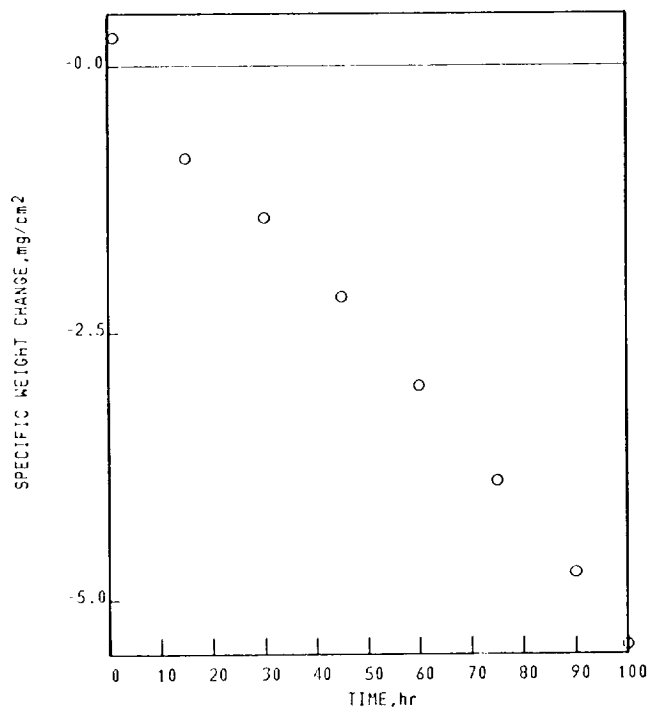
Ni BASE
B-1900

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-130-5

1150°C 1.00hr CYCLES 100.00hr TEST 6.511mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.27
15.00	-0.85
30.00	-1.41
45.00	-2.16
60.00	-2.99
75.00	-3.88
90.00	-4.74
100.00	-5.42

Ni BASE
B-1900

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-130-5

1150°C 1.00hr CYCLES 100.00hr TEST 6.511mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE
100 hr
STANDARD SURFACE
SPINEL, $a_0=8.10\text{\AA}$.
TRI(RUTILE), $d(110)\leq 3.30\text{\AA}$.
NiO
FACE CENTERED CUBIC MATRIX

SPALL
100 hr
COLLECTED SPALL
SPINEL, $a_0=8.05\text{\AA}$.
NiO
SPINEL, $a_0=8.25\text{\AA}$.
TRI(RUTILE), $d(110)\leq 3.30\text{\AA}$.

Ni BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04 001-130-6

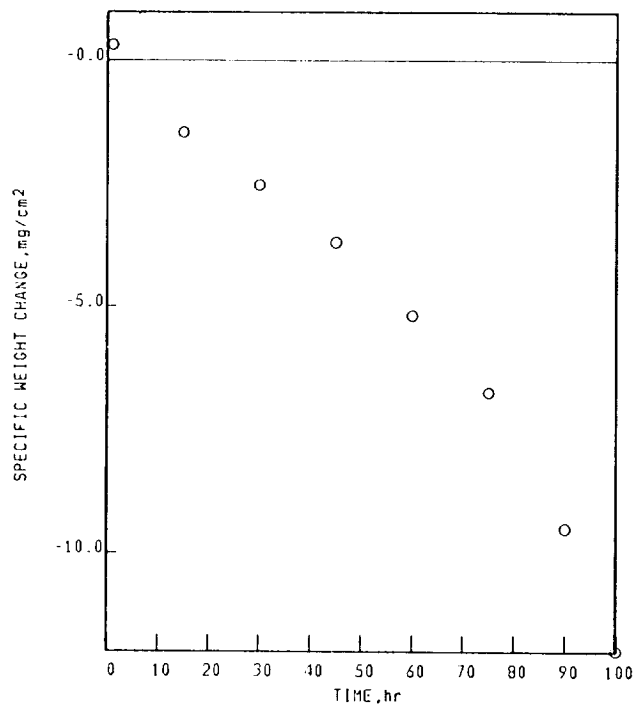
B-1900

1150°C 1.00hr CYCLES

100.00hr TEST 2.290mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr
0.00
1.00
15.00
30.00
45.00
60.00
75.00
90.00
100.00

ΔW/A, mg/cm²
0.00
0.31
-1.48
-2.55
-3.70
-5.17
-6.75
-9.50
-11.99

Ni BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-130 6

B-1900

1150°C 1.00hr CYCLES

100.00hr TEST 2.290mm THICK

STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

100 hr

STANDARD SURFACE

SPINEL, $a_0 = 8.10 \text{ \AA}$.

TRI(RUTILE), $d(110) \leq 3.30 \text{ \AA}$.

NiO

SPINEL, $a_0 = 8.25 \text{ \AA}$.

FACE CENTERED CUBIC MATRIX

SPALL

100 hr

COLLECTED SPALL

NiO

SPINEL, $a_0 = 8.25 \text{ \AA}$.

TRI(RUTILE), $d(110) \leq 3.30 \text{ \AA}$.

SPINEL, $a_0 = 8.05 \text{ \AA}$.

Ni BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-146-5

B-1900

1150°C

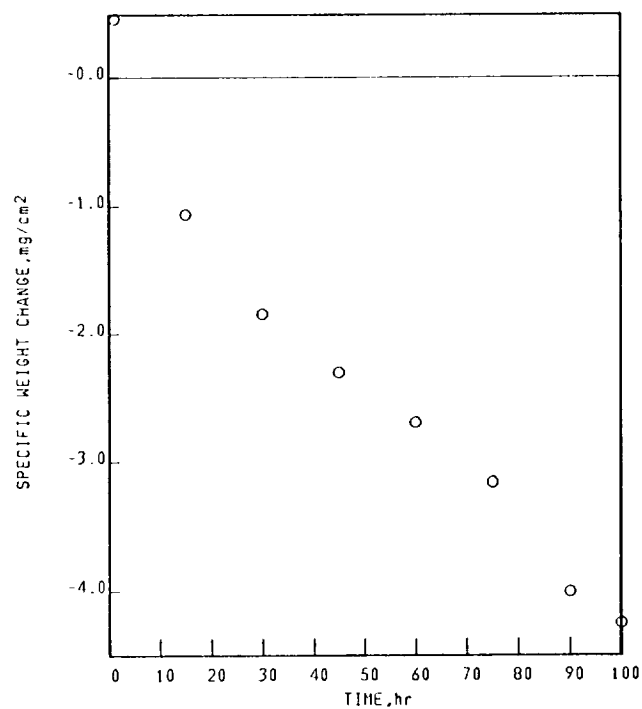
1.00hr CYCLES

100.00hr TEST

3.251mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.46
15.00	-1.06
30.00	-1.84
45.00	-2.30
60.00	-2.69
75.00	-3.15
90.00	-4.00
100.00	-4.25

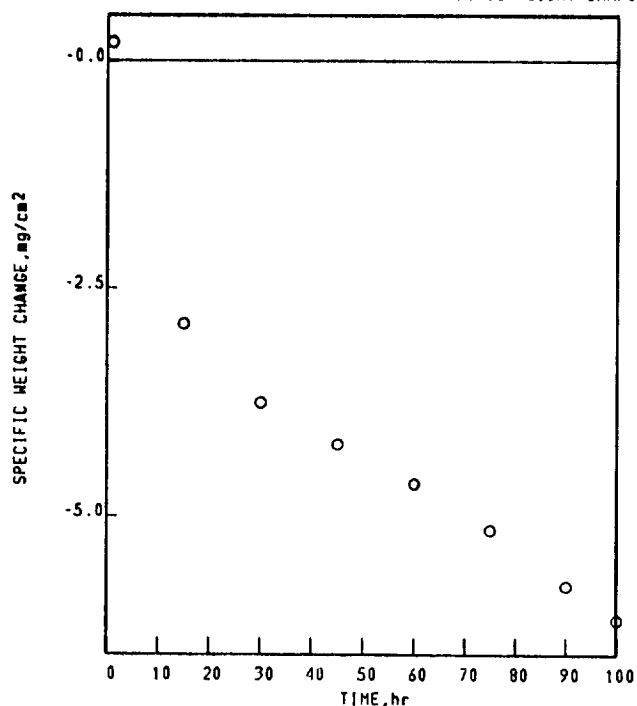
NI BASE
B-1900

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-204-4

1150°C 1.00hr CYCLES 100.00hr TEST 2.321mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.20
15.00	-2.89
30.00	-3.75
45.00	-4.21
60.00	-4.64
75.00	-5.15
90.00	-5.76
100.00	-6.13

NI BASE
B-1900

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-204-4

1150°C 1.00hr CYCLES 100.00hr TEST 2.321mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE
100 hr
STANDARD SURFACE
Al₂O₃
SPINEL, a₀=0.15A.
FACE CENTERED CUBIC MATRIX

SPALL
100 hr
COLLECTED SPALL
NiO
TR[(RUTILE), d(110)>3.30A.
SPINEL, a₀=0.20A.

Ni BASE

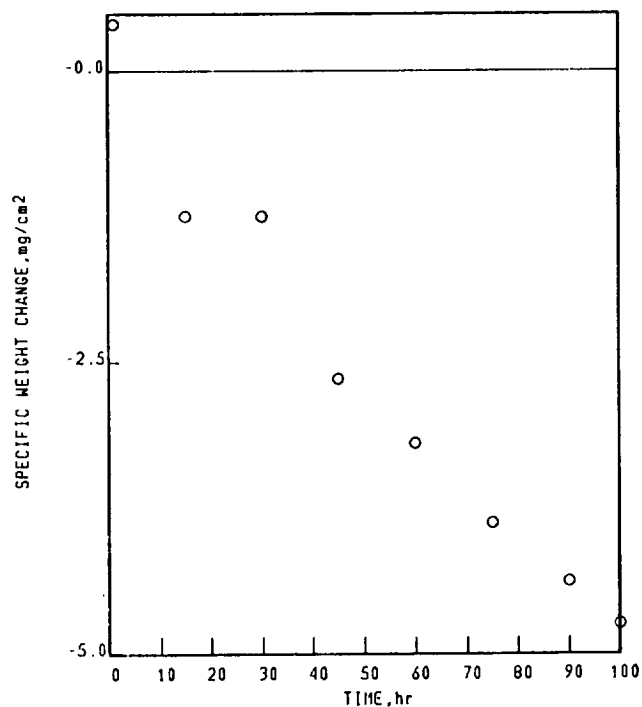
COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-221-1

B-1900

1150°C 1.00hr CYCLES 100.00hr TEST 2.700mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.41
15.00	-1.24
30.00	-1.24
45.00	-2.65
60.00	-3.19
75.00	-3.87
90.00	-4.38
100.00	-4.75

Ni BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-221-1

B-1900

1150°C 1.00hr CYCLES 100.00hr TEST 2.700mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

100 hr

STANDARD SURFACE

SPINEL, $a_0=8.10\text{\AA}$.

Al_2O_3

$\text{Ti}(\text{RUTILE}), d(110) \leq 3.30\text{\AA}$.

FACE CENTERED CUBIC MATRIX

SPALL

100 hr

COLLECTED SPALL

$\text{Ti}(\text{RUTILE}), d(110) \leq 3.30\text{\AA}$.

NiO

SPINEL, $a_0=8.05\text{\AA}$.

SPINEL, $a_0=8.25\text{\AA}$.

Al_2O_3

UNKNOWN LINES, d VALUES

2.64 \AA .

3.60 \AA .

4.38 \AA .

5.09 \AA .

Ni BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-221-5

B-1900

1150°C

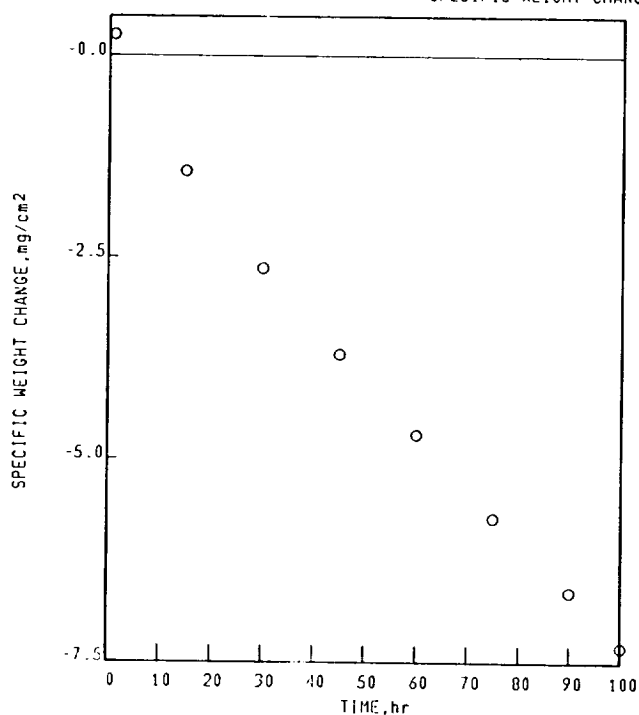
1.00hr CYCLES

100.00hr TEST

6.353mm THICK

+0.51, STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr
0.00
1.00
15.00
30.00
45.00
60.00
75.00
90.00
100.00

ΔW/A, mg/cm²
0.00
0.26
-1.44
-2.63
-3.70
-4.69
-5.72
-6.63
-7.31

Ni BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-221-5

B-1900

1150°C

1.00hr CYCLES

100.00hr TEST

6.353mm THICK

+0.51, STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

100 hr

STANDARD SURFACE

SPINEL, $a_0=8.20\text{\AA}$. Al_2O_3 TRI(RUTILE), $d(110)\leq 3.30\text{\AA}$.

FACE CENTERED CUBIC MATRIX

SPALL

100 hr

COLLECTED SPALL

NiO

SPINEL, $a_0=8.25\text{\AA}$.SPINEL, $a_0=8.10\text{\AA}$.TRI(RUTILE), $d(110)>3.30\text{\AA}$.TRI(RUTILE), $d(110)\leq 3.30\text{\AA}$.

UNKNOWN LINES, d VALUES

5.05Å.

2.65Å.

4.39Å.

Ni BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

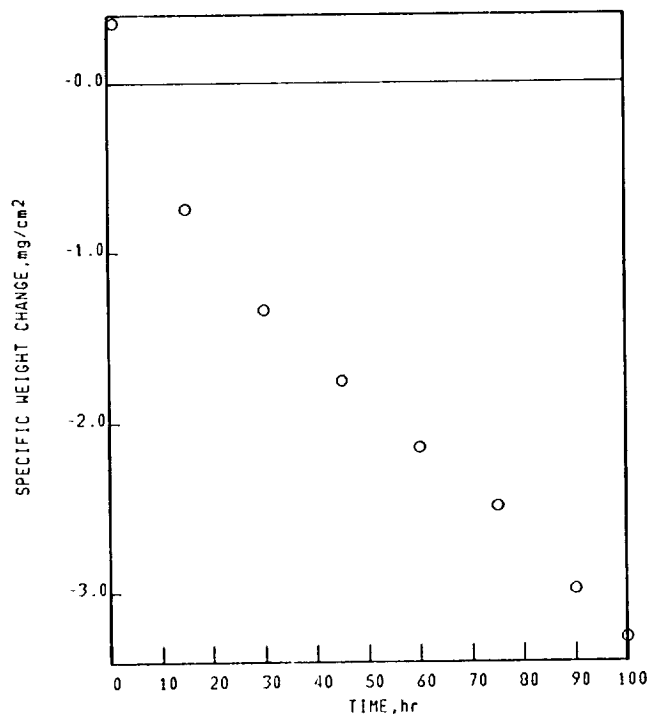
02-04-001-328-1

B-1900

1150°C 1.00hr CYCLES 100.00hr TEST 2.318mm THICK

STATIC AIR(SMP)

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.35
15.00	-0.74
30.00	-1.34
45.00	-1.75
60.00	-2.15
75.00	-2.49
90.00	-2.98
100.00	-3.27

Ni BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-328-1

B-1900

1150°C 1.00hr CYCLES 100.00hr TEST 2.318mm THICK

STATIC AIR(SMP)

X-RAY DIFFRACTION DATA

SURFACE
100 hr
STANDARD SURFACE
SPINEL, $a_0=8.10\text{\AA}$.
 Al_2O_3
 $\text{TRT(RUTILE)}, d(110) \leq 3.30\text{\AA}$.
SPINEL, $a_0=8.25\text{\AA}$.
FACE CENTERED CUBIC MATRIX

SPALL
100 hr
PROBABLE CROSS-SPALL
NiO
SPINEL, $a_0=8.30\text{\AA}$.
 Cr_2O_3
CoO
 $\text{TRT(RUTILE)}, d(110) \leq 3.30\text{\AA}$.

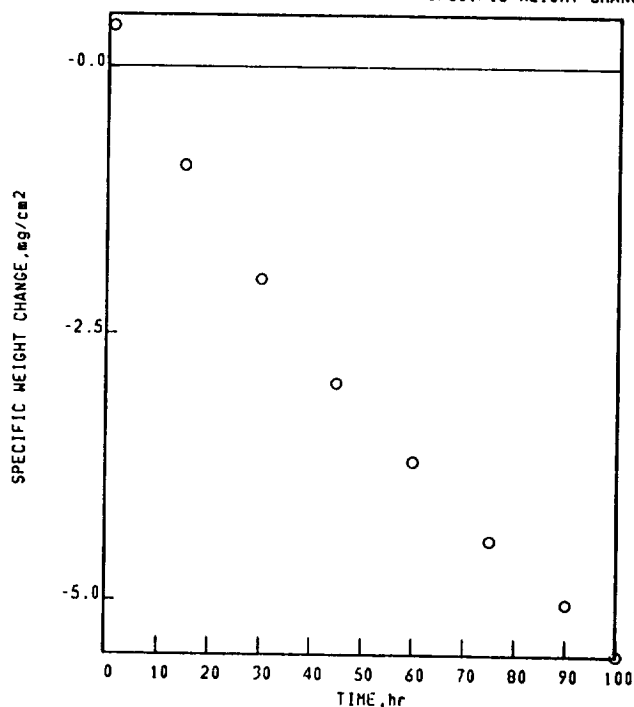
Ni BASE
B-1900

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-321-2

1150°C 1.00hr CYCLES 100.00hr TEST 2.334mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.38
15.00	-0.92
30.00	-1.98
45.00	-2.96
60.00	-3.69
75.00	-4.42
90.00	-5.02
100.00	-5.50

Ni BASE
B-1900

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-321-2

1150°C 1.00hr CYCLES 100.00hr TEST 2.334mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE
100 hr
STANDARD SURFACE
SPINEL, $a_0 = 8.10\text{\AA}$.
 Al_2O_3
SPINEL, $a_0 = 8.25\text{\AA}$.
 $\text{TRI(RUTILE)}, d(110) \leq 3.30\text{\AA}$.
FACE CENTERED CUBIC MATRIX

SPALL
100 hr
COLLECTED SPALL
 NiO
SPINEL, $a_0 = 8.25\text{\AA}$.
SPINEL, $a_0 = 8.05\text{\AA}$.
 $\text{TRI(RUTILE)}, d(110) > 3.30\text{\AA}$.
 $\text{TRI(RUTILE)}, d(110) \leq 3.30\text{\AA}$.
 Cr_2O_3
 Al_2O_3

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

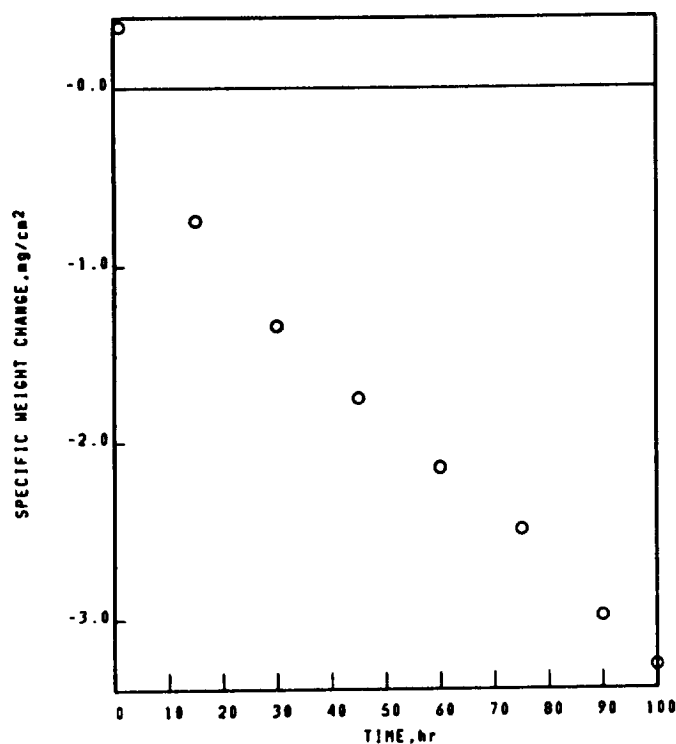
02-04-001-328-1

B-1900

1150°C 1.00hr CYCLES 100.00hr TEST 2.318mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.35
15.00	-0.74
30.00	-1.34
45.00	-1.75
60.00	-2.15
75.00	-2.49
90.00	-2.98
100.00	-3.27

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-328-1

B-1900

1150°C 1.00hr CYCLES 100.00hr TEST 2.318mm THICK

STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE
100 hr
STANDARD SURFACE
SPINEL, $a_0 = 0.10A$.
 Al_2O_3
TRI(RUTILE), $d(110) \leq 3.30A$.
SPINEL, $a_0 = 0.25A$.
FACE CENTERED CUBIC MATRIX

SPALL
100 hr
PROBABLE CROSS-SPALL
NiO
SPINEL, $a_0 = 0.30A$.
 Cr_2O_3
CoO
TRI(RUTILE), $d(110) \leq 3.30A$.

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-337-4

B-1900

1150°C

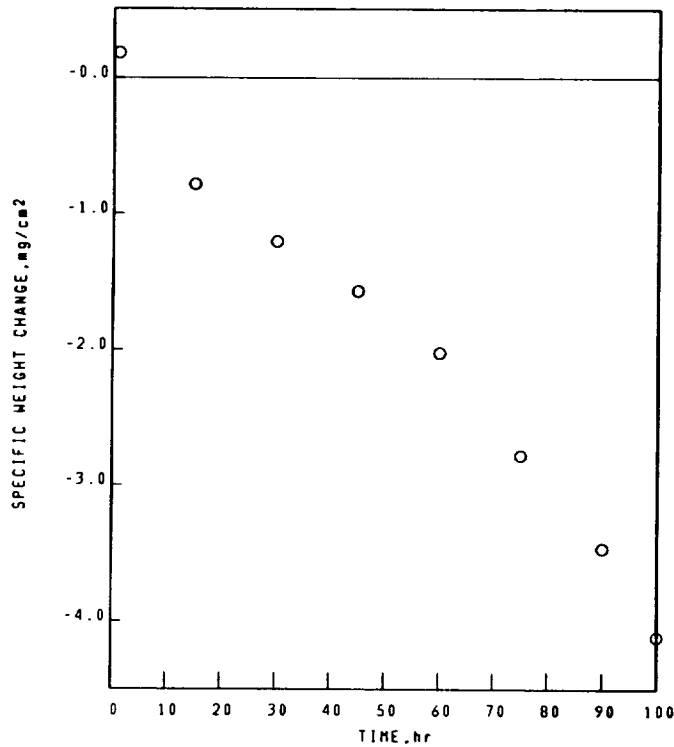
1.00hr CYCLES

100.00hr TEST

2.318mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.18
15.00	-0.79
30.00	-1.21
45.00	-1.57
60.00	-2.02
75.00	-2.78
90.00	-3.47
100.00	-4.11

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-337-4

B-1900

1150°C

1.00hr CYCLES

100.00hr TEST

2.318mm THICK

STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE
100 hr
STANDARD SURFACE
SPINEL, $a_0=8.10\text{\AA}$.
 Al_2O_3
TRI(RUTILE), $d(110)\leq 3.30\text{\AA}$.
SPINEL, $a_0=8.25\text{\AA}$.
FACE CENTERED CUBIC MATRIX

SPALL
100 hr
COLLECTED SPALL
 NiO
SPINEL, $a_0=8.30\text{\AA}$.
TRI(RUTILE), $d(110)\leq 3.30\text{\AA}$.
SPINEL, $a_0=8.10\text{\AA}$.
 Ni(W,Mo)_4 TYPE 1
 Cr_2O_3
 Al_2O_3

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

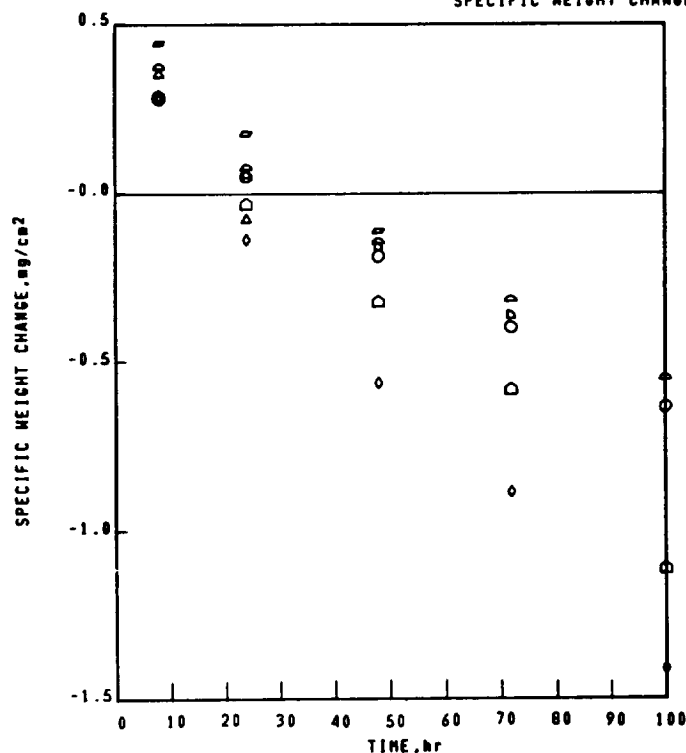
02-04-001-002-6

D-1900

1100°C 1.00hr CYCLES 100.00hr TEST 6.500mm THICK

STATIC AIR(TN D-7404)

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔH/A, mg/cm²
0.00	0.00
8.00	0.20
24.00	0.05
48.00	-0.19
72.00	-0.40
100.00	-0.64

TIME, hr	ΔH/A, mg/cm² 002-1
0.00	0.00
8.00	0.20

TIME, hr	ΔH/A, mg/cm² 002-2
0.00	0.00
8.00	0.35
24.00	-0.08

TIME, hr	ΔH/A, mg/cm² 002-3
0.00	0.00
8.00	0.44
24.00	0.10
48.00	-0.11

TIME, hr	ΔH/A, mg/cm² 002-4
0.00	0.00
8.00	0.20
24.00	0.06
48.00	-0.16
72.00	-0.37

TIME, hr	ΔH/A, mg/cm² 002-5
0.00	0.00
8.00	0.30
24.00	0.08
48.00	-0.14
72.00	-0.32
100.00	-0.55

TIME, hr	ΔH/A, mg/cm² 010-2
0.00	0.00
8.00	0.20
24.00	-0.14
48.00	-0.56
72.00	-0.89
100.00	-1.41

TIME, hr	ΔH/A, mg/cm² 010-3
0.00	0.00
8.00	0.29
24.00	-0.03
48.00	-0.32
72.00	-0.50
100.00	-1.11

X-RAY DIFFRACTION DATA

SURFACE
0 hr
STANDARD SURFACE
Al₂O₃
TRI(RUTILE), d(110) ≤ 3.30A.

FACE CENTERED CUBIC MATRIX

SPALL
0 hr
NO SIGNIFICANT SPALL OBSERVED

002-1

X-RAY DIFFRACTION DATA

SURFACE
100 hr
STANDARD SURFACE
Al₂O₃
TRI(RUTILE), d(110) ≤ 3.30A.

FACE CENTERED CUBIC MATRIX

SPALL
100 hr
COLLECTED SPALL
Al₂O₃
Ni IN SPALL
SPINEL, a₀ = 0.25A.

002-5

Ni BASE

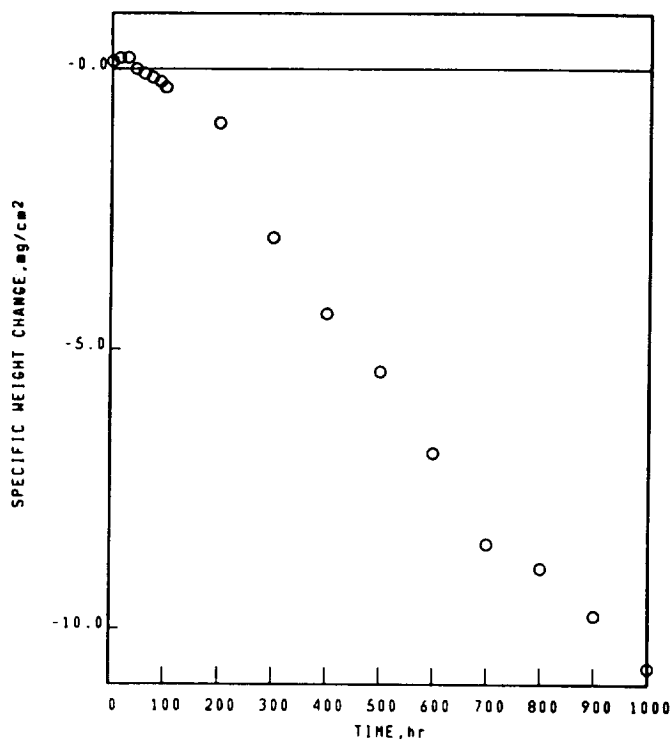
COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-103-3

B-1900

1100°C 1.00hr CYCLES 1000.00hr TEST 6.240mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.14
15.00	0.20
30.00	0.20
45.00	0.00
60.00	-0.08
75.00	-0.15
90.00	-0.23
100.00	-0.33
200.00	-0.97
300.00	-3.00
400.00	-4.36
500.00	-5.40
600.00	-6.86
700.00	-8.47
800.00	-8.90
900.00	-9.76
1000.00	-10.71

Ni BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-103-3

B-1900

1100°C 1.00hr CYCLES 1000.00hr TEST 6.240mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

<p>SURFACE 500 hr SURFACE NOT SATISFACTORY-NO XRD</p>	<p>SPALL 500 hr COLLECTED SPALL NiO TRI(RUTILE), d(110) > 3.30A. SPINEL, a_0 = 8.35A. TRI(RUTILE), d(110) ≤ 3.30A.</p>
<p>600 hr SURFACE NOT SATISFACTORY-NO XRD</p>	<p>600 hr COLLECTED SPALL NiO TRI(RUTILE), d(110) ≤ 3.30A. TRI(RUTILE), d(110) ≤ 3.30A. SPINEL, a_0 = 8.05A. SPINEL, a_0 = 8.30A.</p>

Ni BASE
B-1900

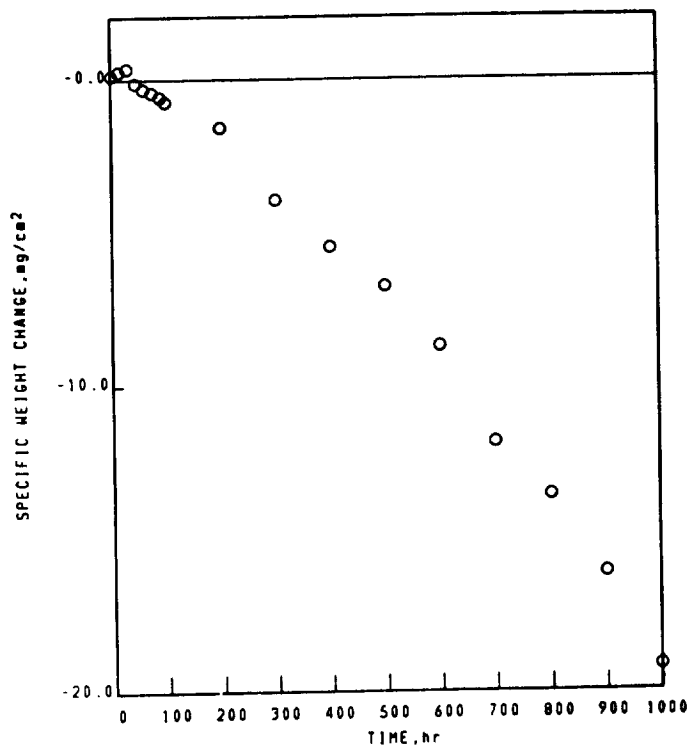
COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-103-4

1100°C 1.00hr CYCLES 1000.00hr TEST 6.240mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.14
15.00	0.26
30.00	0.36
45.00	-0.11
60.00	-0.31
75.00	-0.42
90.00	-0.57
100.00	-0.72
200.00	-1.56
300.00	-3.93
400.00	-5.48
500.00	-6.78
600.00	-8.73
700.00	-11.07
800.00	-13.61
900.00	-16.16
1000.00	-19.10

Ni BASE
B-1900

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-103-4

1100°C 1.00hr CYCLES 1000.00hr TEST 6.240mm THICK

STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

500 hr

SURFACE NOT SATISFACTORY-NO XRD COLLECTED SPALL

SPALL

500 hr

COLLECTED SPALL

NiO

TRI(RUTILE), d(110) ≤ 3.30A.

TRI(RUTILE), d(110) ≤ 3.30A.

SPINEL, a₀ = 0.10A.

SPINEL, a₀ = 0.25A.

600 hr

SURFACE NOT SATISFACTORY-NO XRD COLLECTED SPALL

600 hr

COLLECTED SPALL

NiO

TRI(RUTILE), d(110) > 3.30A.

TRI(RUTILE), d(110) ≤ 3.30A.

SPINEL, a₀ = 0.25A.

SPINEL, a₀ = 0.05A.

Ni BASE

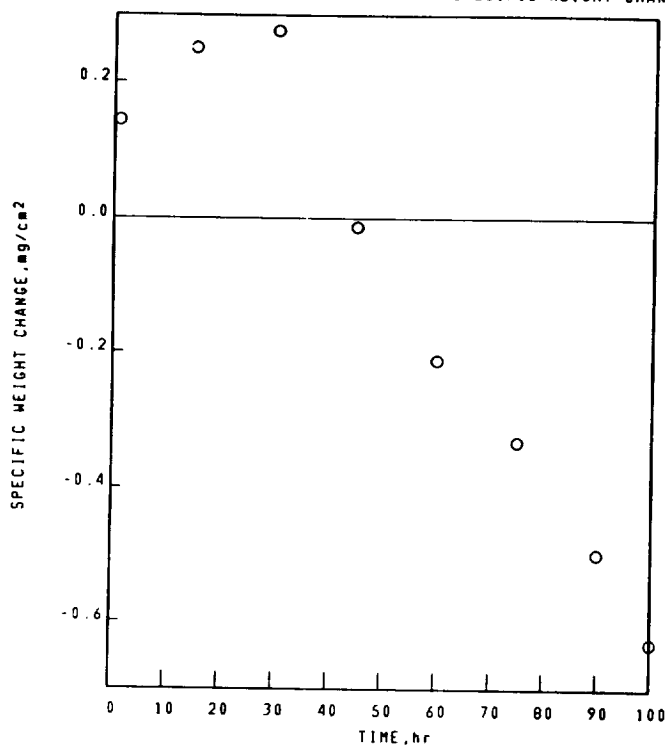
COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-103-5

B-1900

1100°C 1.00hr CYCLES 100.00hr TEST 6.240mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	$\Delta W/A, \text{mg/cm}^2$
0.00	0.00
1.00	0.14
15.00	0.25
30.00	0.28
45.00	-0.01
60.00	-0.21
75.00	-0.33
90.00	-0.50
100.00	-0.63

Ni BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-103-5

B-1900

1100°C 1.00hr CYCLES 100.00hr TEST 6.240mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

500 hr

SURFACE NOT SATISFACTORY-NO XRD COLLECTED SPALL

SPALL

500 hr

NiO
 TRI(RUTILE), $d(110) \leq 3.30\text{\AA}$.

UNKNOWN LINES, d VALUES1.46 \AA .1.43 \AA .1.60 \AA .3.14 \AA .

600 hr

SURFACE NOT SATISFACTORY-NO XRD COLLECTED SPALL

600 hr

COLLECTED SPALL

NiO
 TRI(RUTILE), $d(110) > 3.30\text{\AA}$.
 TRI(RUTILE), $d(110) \leq 3.30\text{\AA}$.
 SPINEL, $a_0 = 0.25\text{\AA}$.

Ni BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

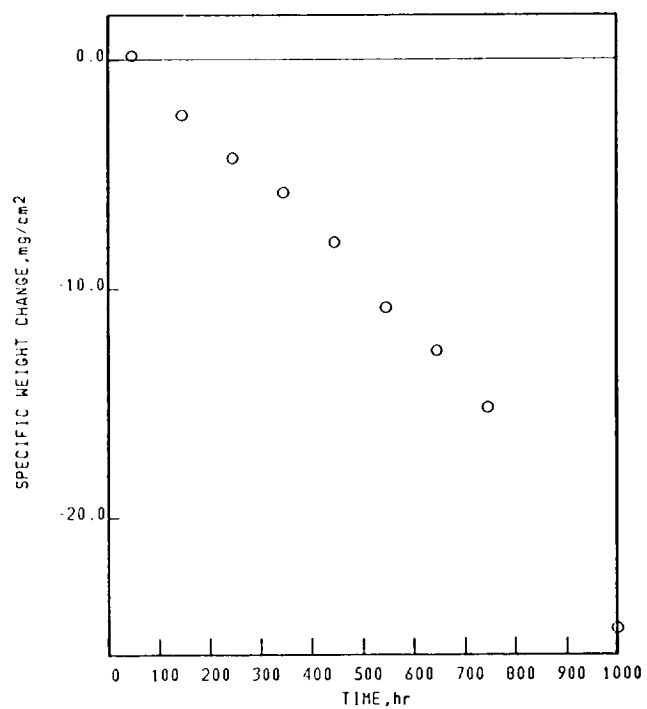
02-04-001-103-7

B-1900

1100°C 1.00hr CYCLES 1000.00hr TEST 6.240mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
46.00	0.17
146.00	-2.43
246.00	-4.28
346.00	-5.77
446.00	-7.97
546.00	-10.84
646.00	-12.74
746.00	-15.22
1000.00	-24.68

Ni BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-115-3

B-1900

1100°C

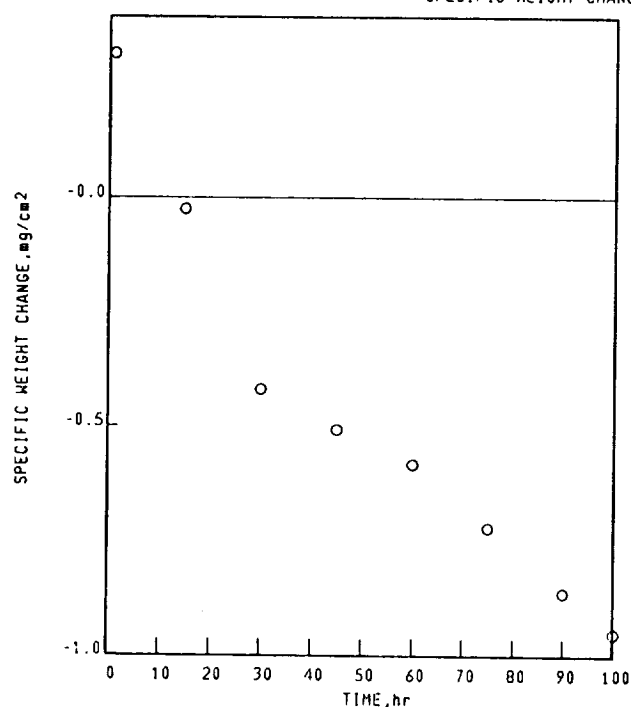
1.00hr CYCLES

100.00hr TEST

2.773mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.32
15.00	-0.03
30.00	-0.42
45.00	-0.51
60.00	-0.58
75.00	-0.72
90.00	-0.86
100.00	-0.95

Ni BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-115-3

B-1900

1100°C

1.00hr CYCLES

100.00hr TEST

2.773mm THICK

STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE
100 hr
STANDARD SURFACE
SPINEL, $a_0=8.10\text{\AA}$.
TRI(RUTILE), $d(110)\leq 3.30\text{\AA}$.
 Al_2O_3
FACE CENTERED CUBIC MATRIX

SPALL
100 hr
COLLECTED SPALL
TRI(RUTILE), $d(110)\leq 3.30\text{\AA}$.
NiO
SPINEL, $a_0=8.20\text{\AA}$.
SPINEL, $a_0=8.10\text{\AA}$.
 Al_2O_3
 Cr_2O_3

Ni BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-115-6

B-1900

1100°C

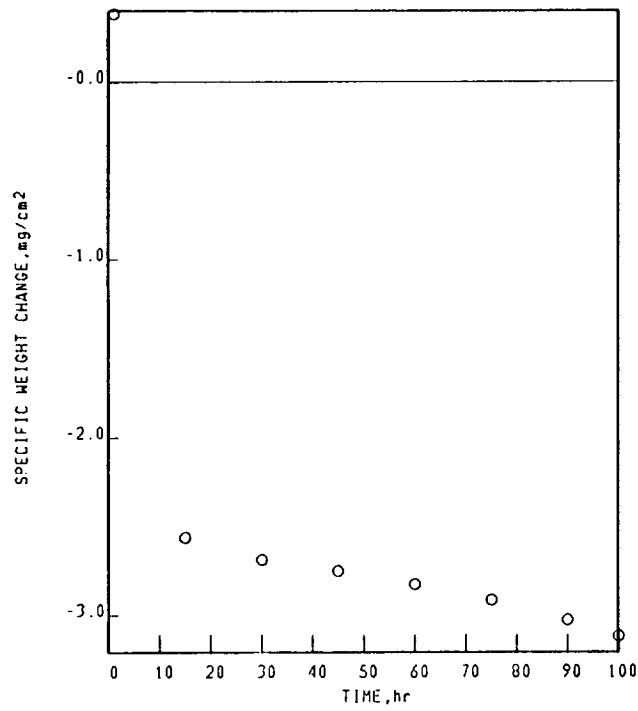
1.00hr CYCLES

100.00hr TEST

2.910mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	$\Delta W/A, \text{mg/cm}^2$
0.00	0.00
1.00	0.38
15.00	-2.57
30.00	-2.69
45.00	-2.75
60.00	-2.83
75.00	-2.92
90.00	-3.03
100.00	-3.12

Ni BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-186-6

B-1900

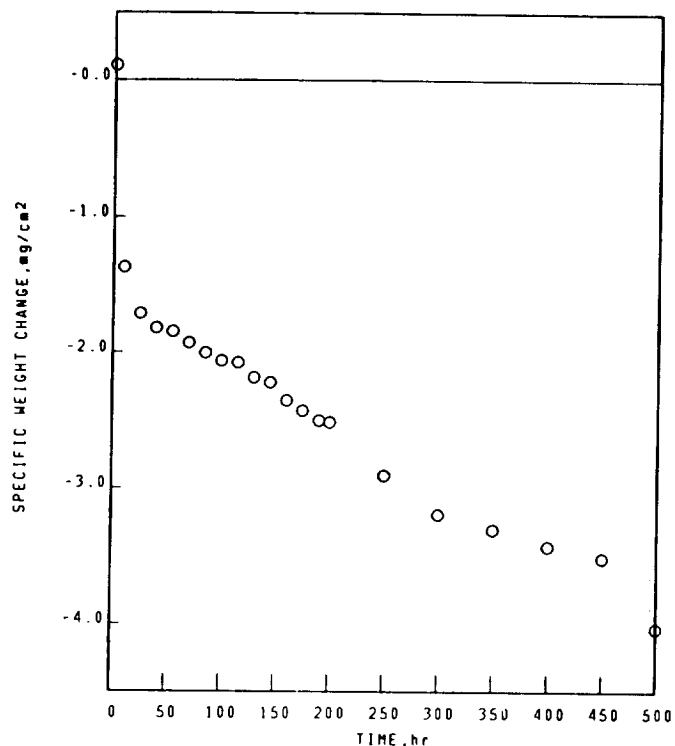
1100°C

1.00hr CYCLES

500.00hr TEST 2.321mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.11
10.00	-1.37
25.00	-1.71
40.00	-1.82
55.00	-1.84
70.00	-1.93
85.00	-2.00
100.00	-2.06
115.00	-2.08
130.00	-2.19
145.00	-2.22
160.00	-2.36
175.00	-2.43
190.00	-2.50
200.00	-2.52
250.00	-2.91
300.00	-3.19
350.00	-3.30
400.00	-3.42
450.00	-3.50
500.00	-4.03

Ni BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-186-6

B-1900

1100°C

1.00hr CYCLES

500.00hr TEST 2.321mm THICK

STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

200 hr

STANDARD SURFACE

SPINEL, $a_0 = 8.10 \text{ \AA}$. Al_2O_3 TRI(RUTILE), $d(110) \leq 3.30 \text{ \AA}$.

FACE CENTERED CUBIC MATRIX

SPALL

200 hr

COLLECTED SPALL

 Al_2O_3

NiO

SPINEL, $a_0 = 8.35 \text{ \AA}$.TRI(RUTILE), $d(110) \leq 3.30 \text{ \AA}$.

500 hr

STANDARD SURFACE

 Al_2O_3 SPINEL, $a_0 = 8.10 \text{ \AA}$.TRI(RUTILE), $d(110) \leq 3.30 \text{ \AA}$.

FACE CENTERED CUBIC MATRIX

500 hr

COLLECTED SPALL

TRI(RUTILE), $d(110) \leq 3.30 \text{ \AA}$.TRI(RUTILE), $d(110) \leq 3.30 \text{ \AA}$.SPINEL, $a_0 = 8.05 \text{ \AA}$.SPINEL, $a_0 = 8.30 \text{ \AA}$.

NI BASE

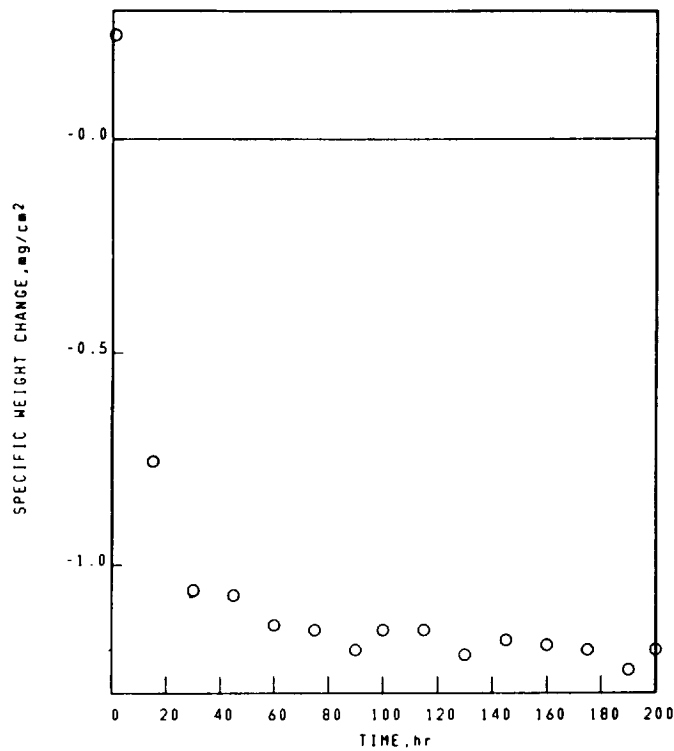
COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-190-5

B-1900

1100°C 1.00hr CYCLES 200.00hr TEST 2.306mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.24
15.00	-0.76
30.00	-1.06
45.00	-1.07
60.00	-1.14
75.00	-1.15
90.00	-1.20
100.00	-1.15
115.00	-1.15
130.00	-1.21
145.00	-1.17
160.00	-1.19
175.00	-1.20
190.00	-1.24
200.00	-1.20

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-190-5

B-1900

1100°C 1.00hr CYCLES 200.00hr TEST 2.306mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

200 hr

STANDARD SURFACE

SPINEL, $a_0=8.10\text{\AA}$.

Al_2O_3

TRI(RUTILE), $d(110)\leq 3.30\text{\AA}$.

FACE CENTERED CUBIC MATRIX

SPALL

200 hr

COLLECTED SPALL

Al_2O_3

TRI(RUTILE), $d(110)\leq 3.30\text{\AA}$.

Cr_2O_3

UNKNOWN LINES, d VALUES

1.38 \AA .

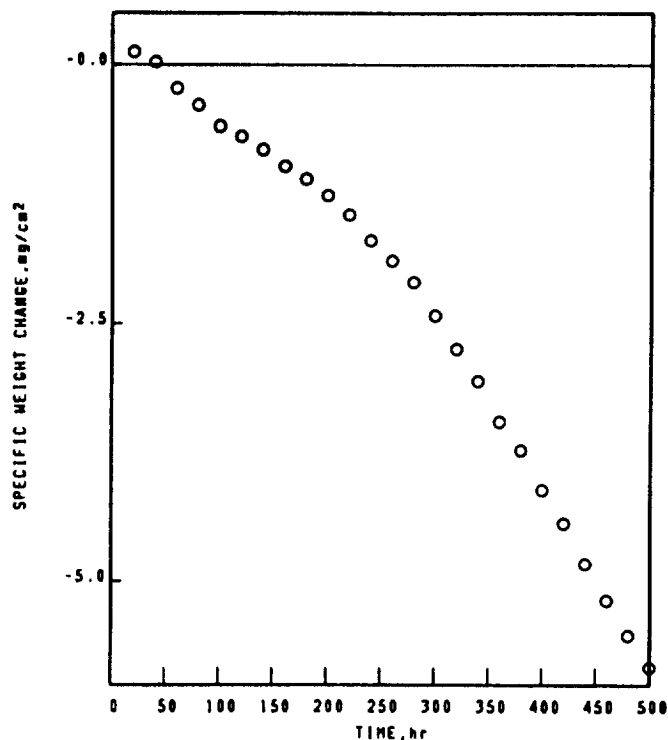
NI BASE
B-1900

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-231-S

1100°C 20.00hr CYCLES 500.00hr TEST 2.331mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
20.00	0.12
40.00	0.02
60.00	-0.22
80.00	-0.39
100.00	-0.50
120.00	-0.68
140.00	-0.81
160.00	-0.97
180.00	-1.09
200.00	-1.26
220.00	-1.44
240.00	-1.69
260.00	-1.89
280.00	-2.18
300.00	-2.42
320.00	-2.75
340.00	-3.06
360.00	-3.44
380.00	-3.72
400.00	-4.10
420.00	-4.42
440.00	-4.82
460.00	-5.18
480.00	-5.52
500.00	-5.83

NI BASE
B-1900

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-231-S

1100°C 20.00hr CYCLES 500.00hr TEST 2.331mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE
500 hr
STANDARD SURFACE
SPINEL, $a_0=0.10A$.
 Al_2O_3
TRI(RUTILE), $d(110) \leq 3.30A$.
FACE CENTERED CUBIC MATRIX

SPALL
500 hr
COLLECTED SPALL
 Al_2O_3
SPINEL, $a_0=0.10A$.
NiO
SPINEL, $a_0=0.25A$.
TRI(RUTILE), $d(110) \leq 3.30A$.
 Cr_2O_3

NI BASE

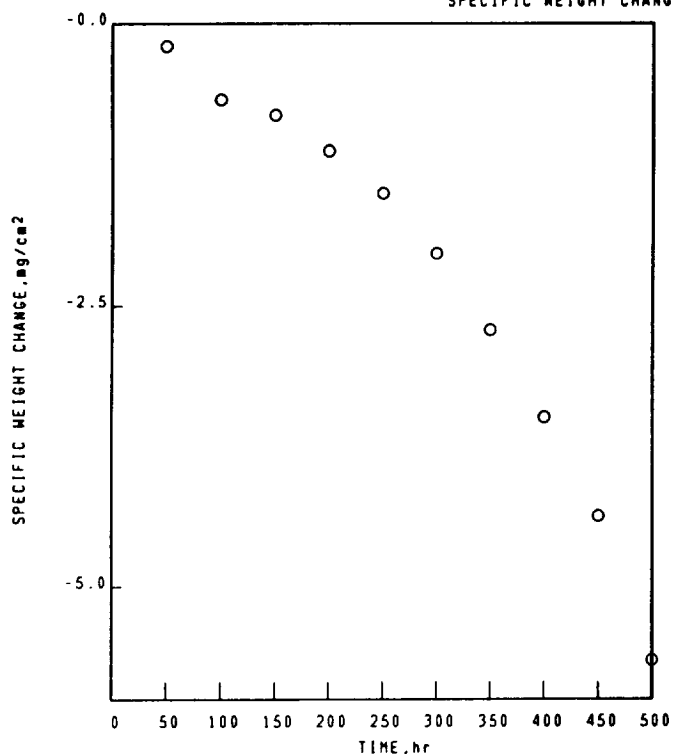
COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-238-5

B-1900

1100°C 50.00hr CYCLES 500.00hr TEST 2.325mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
50.00	-0.20
100.00	-0.67
150.00	-0.81
200.00	-1.12
250.00	-1.50
300.00	-2.03
350.00	-2.72
400.00	-3.49
450.00	-4.37
500.00	-5.65

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-238-5

B-1900

1100°C 50.00hr CYCLES 500.00hr TEST 2.325mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

500 hr

STANDARD SURFACE

SPINEL, $a_0 = 0.10 \text{ Å}$.

Al_2O_3

TRI(RUTILE), $d(110) \leq 3.30 \text{ Å}$.

FACE CENTERED CUBIC MATRIX

SPALL

500 hr

COLLECTED SPALL

Al_2O_3

SPINEL, $a_0 = 0.10 \text{ Å}$.

NiO

SPINEL, $a_0 = 0.25 \text{ Å}$.

TRI(RUTILE), $d(110) \leq 3.30 \text{ Å}$.

Cr_2O_3

NI BASE

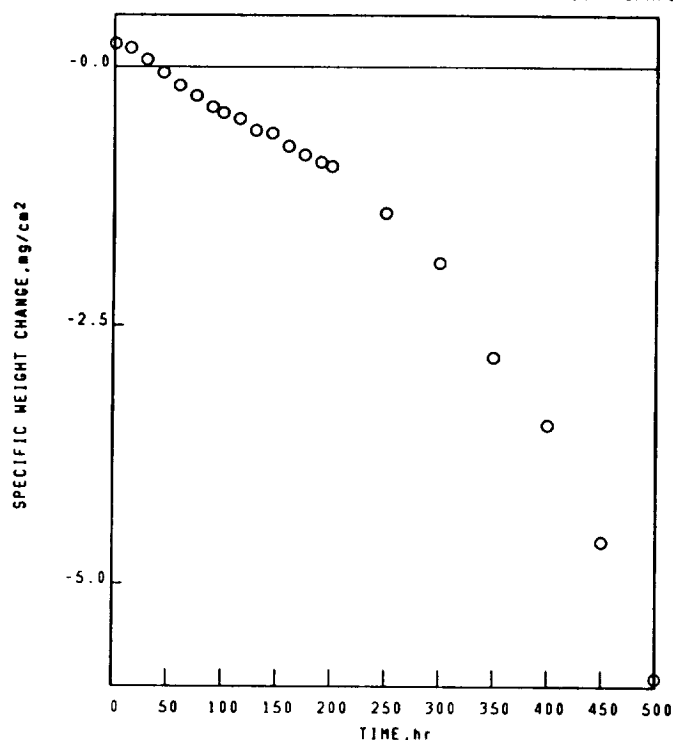
COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-276-6

B-1900

1100°C 1.00hr CYCLES 500.00hr TEST 2.319mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.22
15.00	0.18
30.00	0.07
45.00	-0.06
60.00	-0.18
75.00	-0.28
90.00	-0.39
100.00	-0.45
115.00	-0.51
130.00	-0.62
145.00	-0.65
160.00	-0.77
175.00	-0.86
190.00	-0.93
200.00	-0.97
250.00	-1.42
300.00	-1.89
350.00	-2.81
400.00	-3.46
450.00	-4.59
500.00	-5.92

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-276-6

B-1900

1100°C 1.00hr CYCLES 500.00hr TEST 2.319mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

200 hr

STANDARD SURFACE

SPINEL, $a_0=8.10\text{\AA}$.

TRI(RUTILE), $d(110)\leq 3.30\text{\AA}$.

Al_2O_3

FACE CENTERED CUBIC MATRIX

SPALL

200 hr

COLLECTED SPALL

NiO

SPINEL, $a_0=8.30\text{\AA}$.

TRI(RUTILE), $d(110)>3.30\text{\AA}$.

SPINEL, $a_0=8.10\text{\AA}$.

UNKNOWN LINES, d VALUES

5.06Å.

2.55Å.

1.89Å.

500 hr

STANDARD SURFACE

SPINEL, $a_0=8.10\text{\AA}$.

Al_2O_3

NiO

TRI(RUTILE), $d(110)\leq 3.30\text{\AA}$.

FACE CENTERED CUBIC MATRIX

500 hr

COLLECTED SPALL

NiO

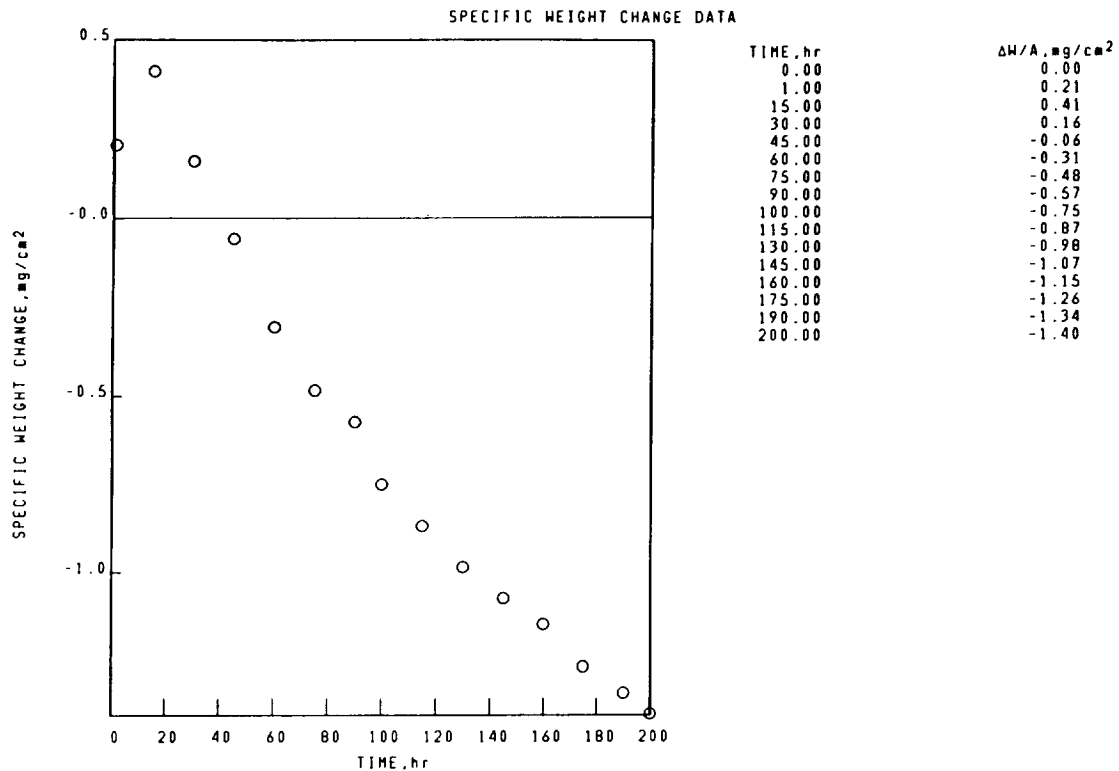
SPINEL, $a_0=8.05\text{\AA}$.

Al_2O_3

TRI(RUTILE), $d(110)>3.30\text{\AA}$.

SPINEL, $a_0=8.25\text{\AA}$.

Ni BASE COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS 02-04-001-324-2
 B-1900 1100°C 1.00hr CYCLES 200.00hr TEST 2.333mm THICK STATIC AIR



Ni BASE COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS 02-04-001-324-2
 B-1900 1100°C 1.00hr CYCLES 200.00hr TEST 2.333mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

<p>SURFACE 200 hr STANDARD SURFACE SPINEL, $a_0=8.10\text{\AA}$. Al_2O_3 TRI(RUTILE), $d(110)\leq 3.30\text{\AA}$. FACE CENTERED CUBIC MATRIX</p>	<p>SPALL 200 hr COLLECTED SPALL NiO TRI(RUTILE), $d(110)\leq 3.30\text{\AA}$. SPINEL, $a_0=8.25\text{\AA}$. SPINEL, $a_0=8.10\text{\AA}$. UNKNOWN LINES, d VALUES 3.10\AA. 3.69\AA. 3.57\AA.</p>
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Ni BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-327-1

B-1900

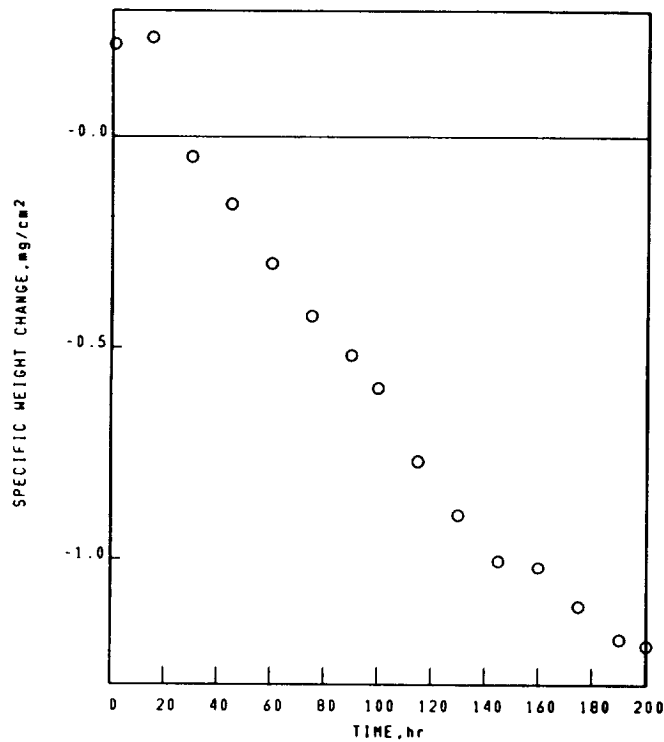
1100°C

1.00hr CYCLES

200.00hr TEST 2.340mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.22
15.00	0.24
30.00	-0.05
45.00	-0.16
60.00	-0.30
75.00	-0.42
90.00	-0.52
100.00	-0.60
115.00	-0.77
130.00	-0.89
145.00	-1.00
160.00	-1.02
175.00	-1.11
190.00	-1.19
200.00	-1.21

Ni BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-327-1

B-1900

1100°C

1.00hr CYCLES

200.00hr TEST 2.340mm THICK

STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

200 hr

STANDARD SURFACE

Al₂O₃SPINEL, $\theta_0=8.05\text{\AA}$.

FACE CENTERED CUBIC MATRIX

SPALL

200 hr

PROBABLE CROSS-SPALL

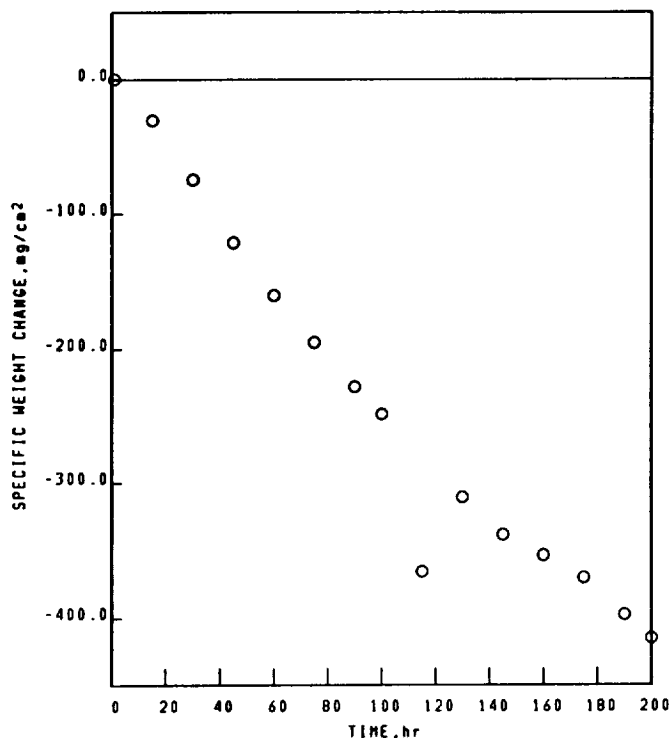
SPINEL, $\theta_0=8.30\text{\AA}$.

CoO

TRI(RUTILE), $d(110)\leq 3.30\text{\AA}$.

Ni BASE COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS 02-04-001-336-4
 B-1900 1100°C 1.00hr CYCLES 200.00hr TEST 2.317mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.17
15.00	-30.30
30.00	-74.68
45.00	-121.38
60.00	-159.93
75.00	-194.07
90.00	-228.06
100.00	-248.76
115.00	-365.43
130.00	-310.86
145.00	-338.69
160.00	-353.51
175.00	-369.90
190.00	-397.49
200.00	-414.90

Ni BASE COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS 02-04-001-336-4
 B-1900 1100°C 1.00hr CYCLES 200.00hr TEST 2.317mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE 200 hr STANDARD SURFACE NiO SPINEL, $a_0=8.15\text{\AA}$. TR(RUTILE), $d(110)\leq 3.30\text{\AA}$. Ni(W,Mo)O ₄ TYPE 2 FACE CENTERED CUBIC MATRIX	SPALL 200 hr COLLECTED SPALL NiO TR(RUTILE), $d(110)>3.30\text{\AA}$. SPINEL, $a_0=8.15\text{\AA}$. Ni(W,Mo)O ₄ TYPE 2
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NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-096-2

B-1900

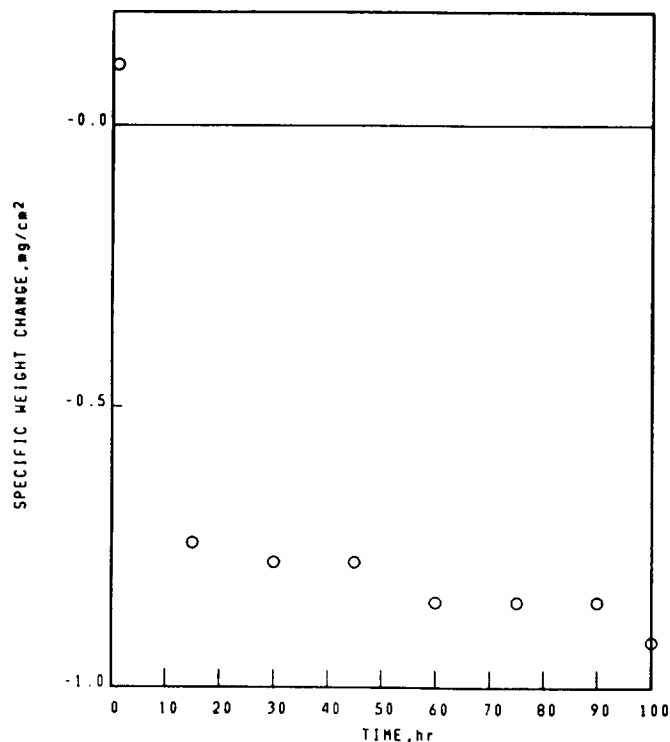
1093°C

1.00hr CYCLES

100.00hr TEST 3.251mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.11
15.00	-0.74
30.00	-0.78
45.00	-0.78
60.00	-0.85
75.00	-0.85
90.00	-0.85
100.00	-0.92

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-096-2

B-1900

1093°C

1.00hr CYCLES

100.00hr TEST 3.251mm THICK

STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

100 hr

STANDARD SURFACE

SPINEL, $\theta_0 = 8.10^\circ$

Al_2O_3

NiO

SPALL

100 hr

COLLECTED SPALL

NiO

SPINEL, $\theta_0 = 8.20^\circ$

FACE CENTERED CUBIC MATRIX

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

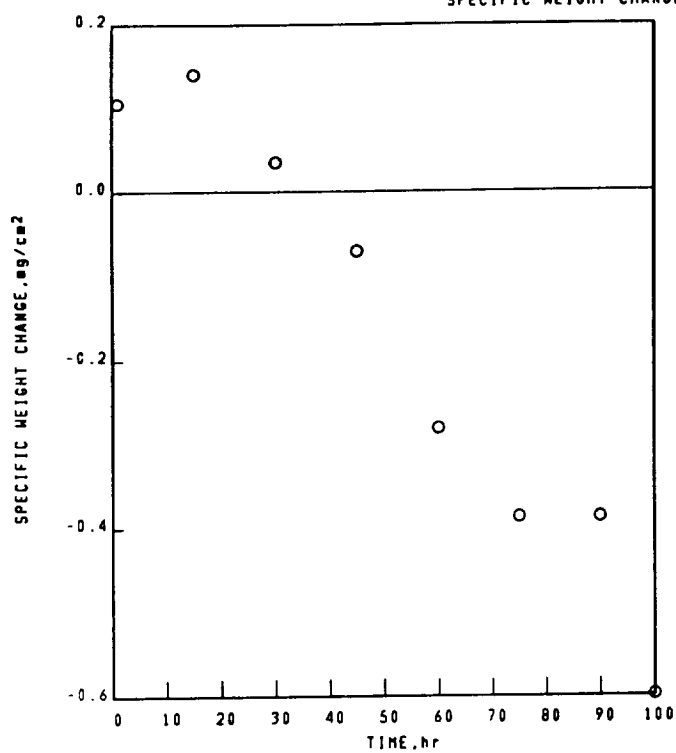
02-04-001-143-3

B-1900

1093°C 1.00hr CYCLES 100.00hr TEST 3.277mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.11
15.00	0.14
30.00	0.04
45.00	-0.07
60.00	-0.28
75.00	-0.39
90.00	-0.39
100.00	-0.60

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-098-1

B-1900

1038°C

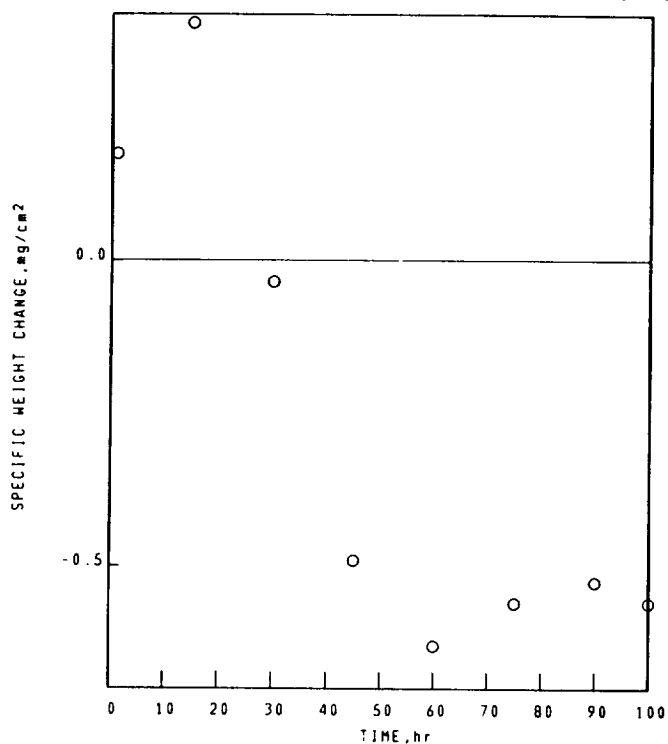
1.00hr CYCLES

100.00hr TEST

3.302mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.18
15.00	0.39
30.00	-0.04
45.00	-0.49
60.00	-0.63
75.00	-0.56
90.00	-0.53
100.00	-0.56

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-098-1

B-1900

1038°C

1.00hr CYCLES

100.00hr TEST

3.302mm THICK

STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

100 hr

STANDARD SURFACE

SPINEL, $a_0 = 8.05 \text{ \AA}$.

TRIRUTILE, $d(110) \leq 3.30 \text{ \AA}$.

FACE CENTERED CUBIC MATRIX

SPALL

100 hr

COLLECTED SPALL

NiO

SPINEL, $a_0 = 8.20 \text{ \AA}$.

ni BASE

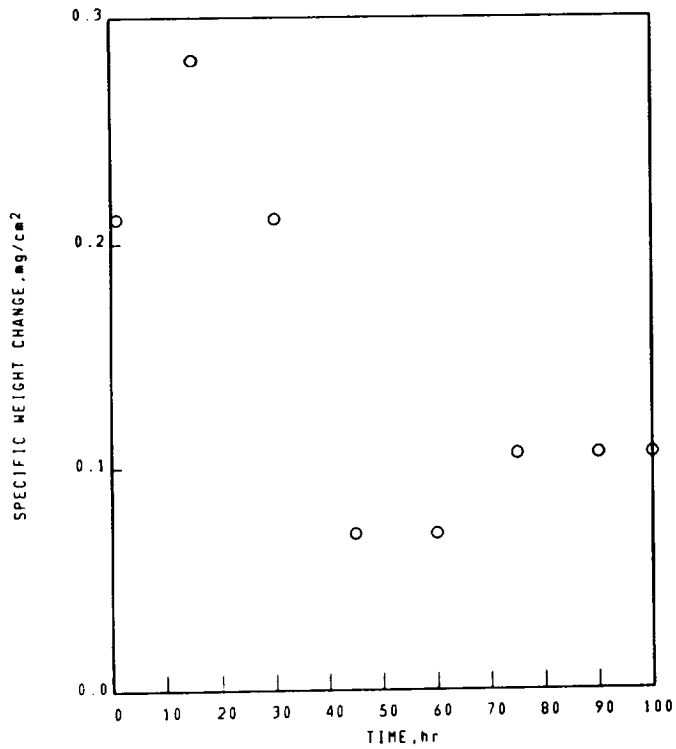
COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-098-2

B-1900

1038°C 1.00hr CYCLES 100.00hr TEST 3.302mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.21
15.00	0.28
30.00	0.21
45.00	0.07
60.00	0.07
75.00	0.11
90.00	0.11
100.00	0.11

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-001-006-6

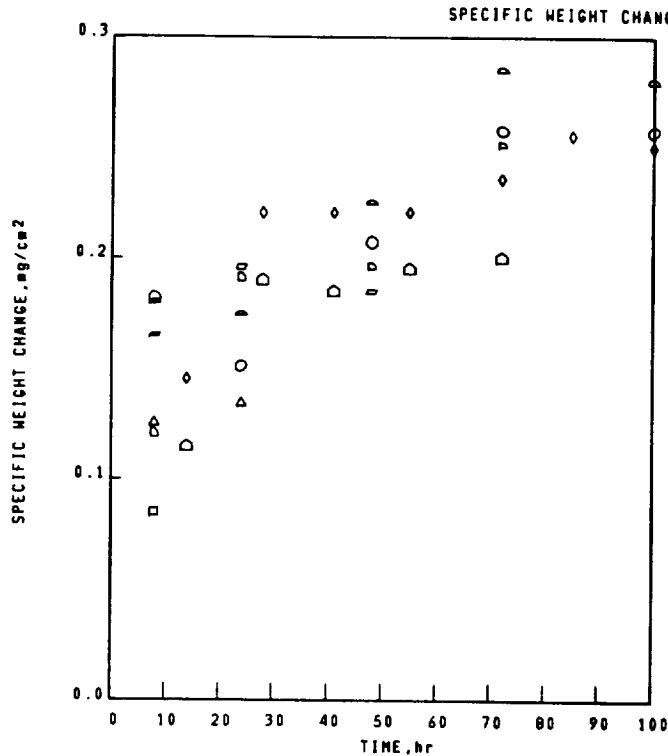
B-1980

1000°C

1.00hr CYCLES

100.00hr TEST 6.500mm THICK

STATIC AIR (TN D-7484)



○ 02-04-001-006-6
□ 02-04-001-006-1
△ 02-04-001-006-2
◇ 02-04-001-006-3
▽ 02-04-001-006-4
+ 02-04-001-006-5
* 02-04-001-009-1
x 02-04-001-009-6

TIME, hr	ΔH/A, mg/cm²
0.00	0.00
8.00	0.10
24.00	0.15
48.00	0.21
72.00	0.26
100.00	0.26
TIME, hr	ΔH/A, mg/cm² 006-1
0.00	0.00
8.00	0.08
TIME, hr	ΔH/A, mg/cm² 006-2
0.00	0.00
8.00	0.13
24.00	0.14
TIME, hr	ΔH/A, mg/cm² 006-3
0.00	0.00
8.00	0.17
24.00	0.20
48.00	0.19
TIME, hr	ΔH/A, mg/cm² 006-4
0.00	0.00
8.00	0.12
24.00	0.19
48.00	0.20
72.00	0.25
TIME, hr	ΔH/A, mg/cm² 006-5
0.00	0.00
8.00	0.10
24.00	0.18
48.00	0.23
72.00	0.29
100.00	0.20
TIME, hr	ΔH/A, mg/cm² 009-1
0.00	0.00
14.00	0.15
20.00	0.22
41.00	0.22
72.00	0.24
100.00	0.25
55.00	0.22
85.00	0.26
TIME, hr	ΔH/A, mg/cm² 009-6
0.00	0.00
14.00	0.12
28.00	0.19
41.00	0.19
72.00	0.28
55.00	0.20

X-RAY DIFFRACTION DATA

SURFACE 0 hr SPALL 0 hr 006-1
STANDARD SURFACE NO SIGNIFICANT SPALL OBSERVED
Al₂O₃
Cr₂O₃
FACE CENTERED CUBIC MATRIX

X-RAY DIFFRACTION DATA

SURFACE 100 hr SPALL 100 hr 006-5
STANDARD SURFACE NO SIGNIFICANT SPALL OBSERVED
Al₂O₃
TRI(RUTILE), d(110) ≤ 3.30Å.
FACE CENTERED CUBIC MATRIX

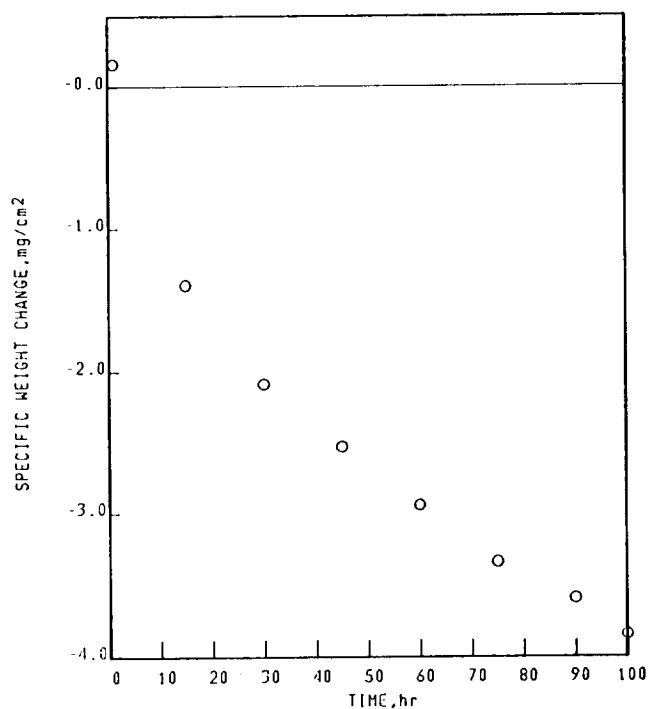
Ni BASE
B-1900-Hf

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-002-323-3

1150°C 1.00hr CYCLES 100.00hr TEST 2.310mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔH/A, mg/cm²
0.00	0.00
1.00	0.16
15.00	-1.39
30.00	-2.09
45.00	-2.53
60.00	-2.94
75.00	-3.34
90.00	-3.59
100.00	-3.85

Ni BASE
B-1900-Hf

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-002-323-3

1150°C 1.00hr CYCLES 100.00hr TEST 2.310mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE
100 hr
STANDARD SURFACE
SPINEL, $a_0=8.10\text{\AA}$.
HfO₂
Al₂O₃
TRI(RUTILE), $d(110)\leq 3.30\text{\AA}$.
FACE CENTERED CUBIC MATRIX

SPALL
100 hr
PROBABLE CROSS-SPALL
NiO
SPINEL, $a_0=8.30\text{\AA}$.
TRI(RUTILE), $d(110)\leq 3.30\text{\AA}$.
Ni(W,Mo)O₄ TYPE 1
CoO

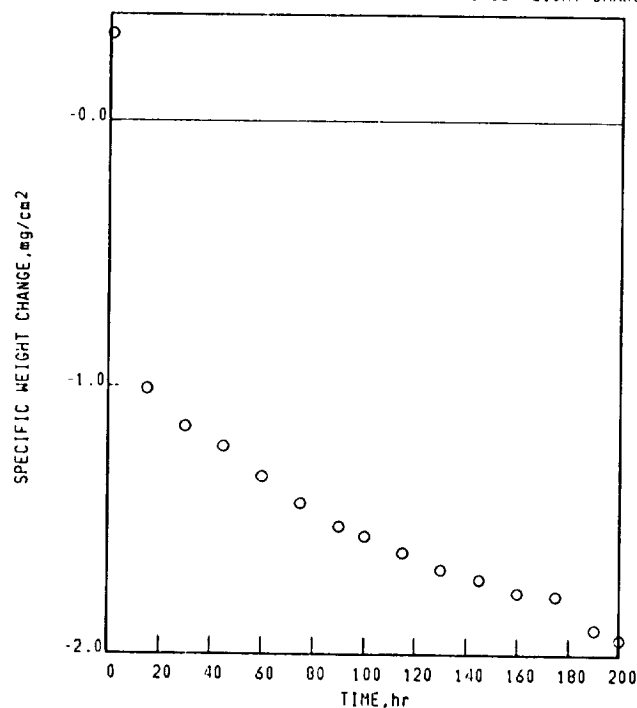
Ni BASE
B-1900+Hf

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-002-190-4

1100°C 1.00hr CYCLES 200.00hr TEST 2.342mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.32
15.00	-1.01
30.00	-1.15
45.00	-1.22
60.00	-1.33
75.00	-1.43
90.00	-1.52
100.00	-1.56
115.00	-1.62
130.00	-1.68
145.00	-1.72
160.00	-1.77
175.00	-1.78
190.00	-1.91
200.00	-1.94

Ni BASE
B-1900+Hf

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-002-190-4

1100°C 1.00hr CYCLES 200.00hr TEST 2.342mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE
200 hr
STANDARD SURFACE
SPINEL, $a_0=8.10\text{\AA}$.
 Al_2O_3
 $\text{TRT(RUTILE)}, d(110)\leq 3.30\text{\AA}$.
FACE CENTERED CUBIC MATRIX

SPALL
200 hr
COLLECTED SPALL
 Al_2O_3
 $\text{TRT(RUTILE)}, d(110)\leq 3.30\text{\AA}$.
SPINEL, $a_0=8.20\text{\AA}$.

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

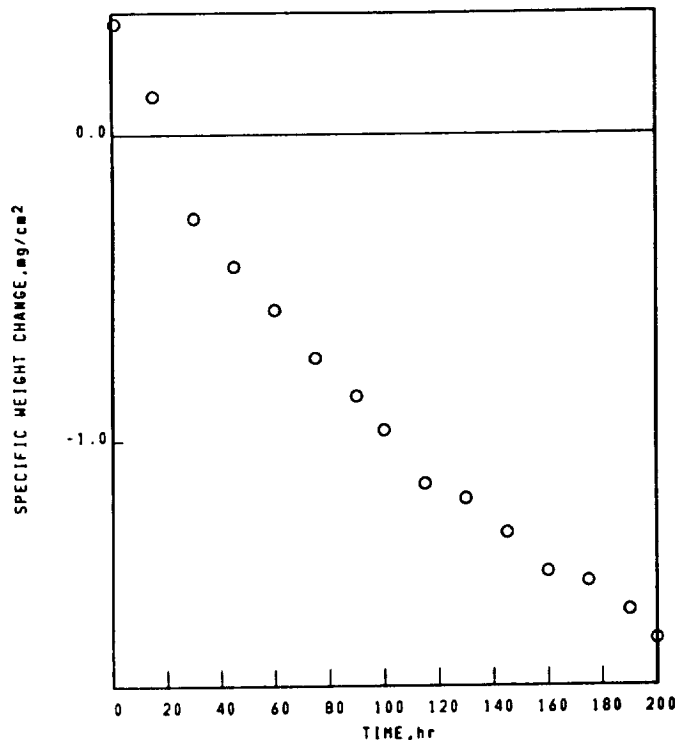
02-04-002-326-3

B-1900-H1

1100°C 1.00hr CYCLES 200.00hr TEST 2.330mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.36
15.00	0.13
30.00	-0.27
45.00	-0.43
60.00	-0.57
75.00	-0.73
90.00	-0.85
100.00	-0.97
115.00	-1.14
130.00	-1.19
145.00	-1.30
160.00	-1.42
175.00	-1.46
190.00	-1.55
200.00	-1.65

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-002-326-3

B-1900-H1

1100°C 1.00hr CYCLES 200.00hr TEST 2.330mm THICK

STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

200 hr

STANDARD SURFACE

SPINEL, $a_0 = 0.05A$.

Al_2O_3

$TRT(RUTILE), d(110) \leq 3.30A$.

HfO_2

FACE CENTERED CUBIC MATRIX

SPALL

200 hr

PROBABLE CROSS-SPALL

SPINEL, $a_0 = 0.35A$.

CoO

Al_2TiO_5

$TRT(RUTILE), d(110) \leq 3.30A$.

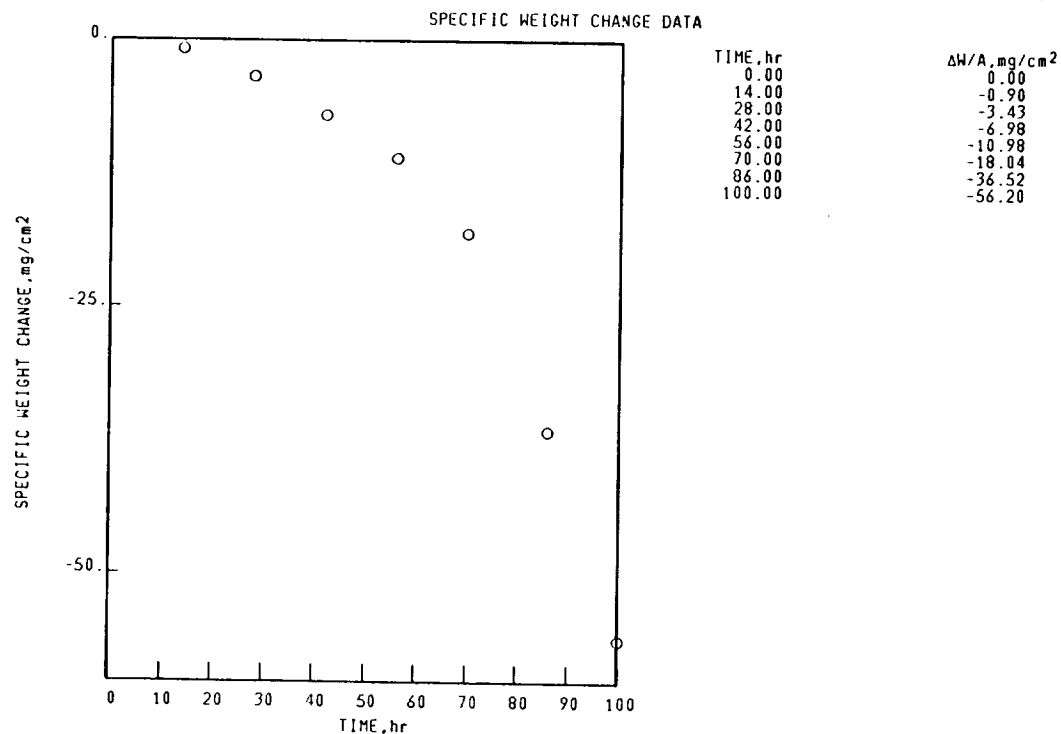
Ni BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-003-041-6

IN-100

1150°C 1.00hr CYCLES 100.00hr TEST 2.408mm THICK STATIC AIR



Ni BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-003-041-6

IN-100

1150°C 1.00hr CYCLES 100.00hr TEST 2.408mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

100 hr

STANDARD SURFACE

SPINEL, $a_0=8.10\text{\AA}$.

UNKNOWN LINES, d VALUES

2.57\AA.

3.29\AA.

3.52\AA.

SPALL

100 hr

COLLECTED SPALL

NiO

SPINEL, $a_0=8.25\text{\AA}$.

FACE CENTERED CUBIC MATRIX

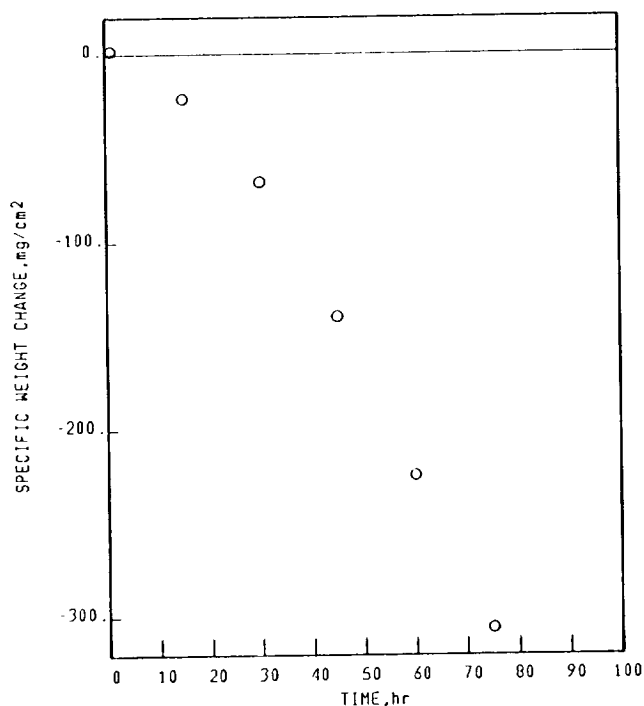
NI BASE
IN-100

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-003-095-3

1150°C 1.00hr CYCLES 75.00hr TEST 3.230mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	$\Delta W/A, \text{mg/cm}^2$
0.00	0.00
1.00	1.77
15.00	-23.70
30.00	-67.54
45.00	-139.84
60.00	-224.20
75.00	-306.01

NI BASE
IN-100

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-003-095-3

1150°C 1.00hr CYCLES 75.00hr TEST 3.230mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE
75 hr
STANDARD SURFACE
SPINEL, $a_0=8.30\text{\AA}$.

SPALL
75 hr
COLLECTED SPALL
NiO
SPINEL, $a_0=8.25\text{\AA}$.

FACE CENTERED CUBIC MATRIX

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-003-105-1

IN-100

1150°C

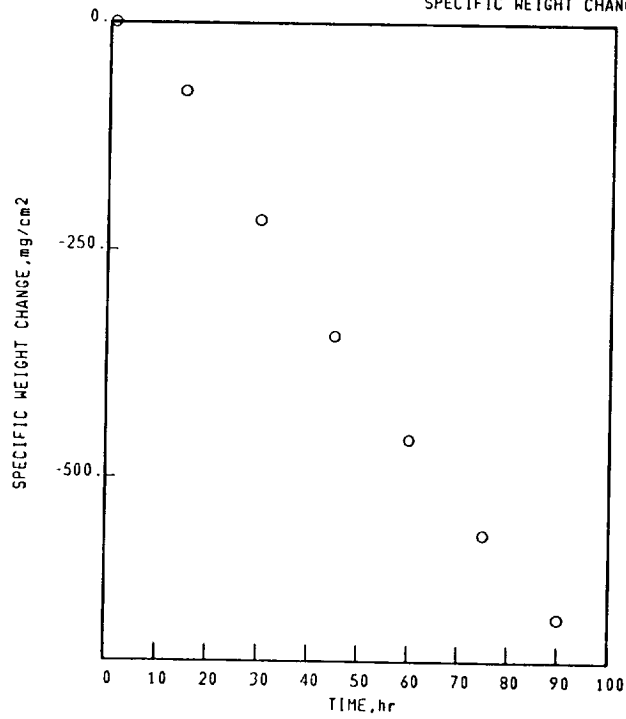
1.00hr CYCLES

90.00hr TEST

2.620mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	-0.01
15.00	-75.43
30.00	-217.51
45.00	-343.81
60.00	-457.74
75.00	-561.97
90.00	-652.69

Ni BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-003-105-2

IN-100

1150°C

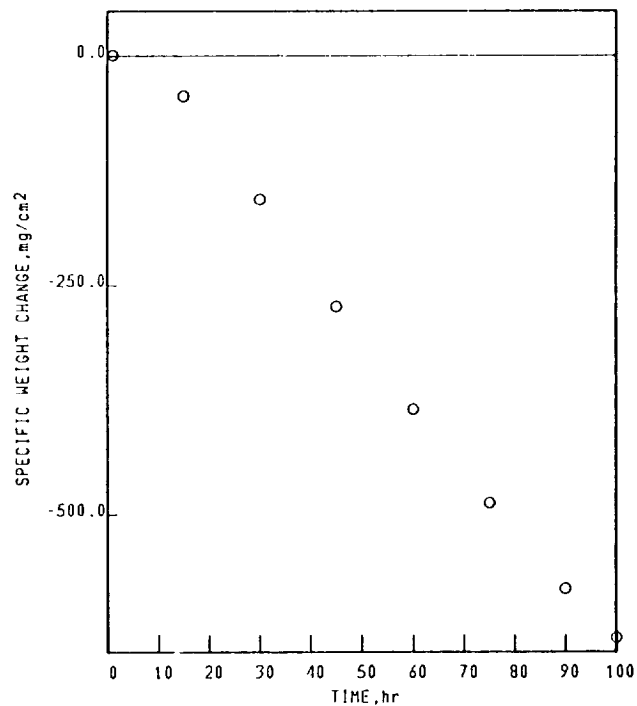
1.00hr CYCLES

100.00hr TEST

2.625mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.69
15.00	-42.66
30.00	-155.34
45.00	-273.51
60.00	-384.80
75.00	-487.43
90.00	-581.66
100.00	-635.19

Ni BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-003-105-2

IN-100

1150°C

1.00hr CYCLES

100.00hr TEST

2.625mm THICK

STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

100 hr

STANDARD SURFACE

SPINEL, $a_0=8.25\text{\AA}$.

Cr₂O₃

SPALL

100 hr

COLLECTED SPALL

NiO

SPINEL, $a_0=8.20\text{\AA}$.

FACE CENTERED CUBIC MATRIX

NI BASE

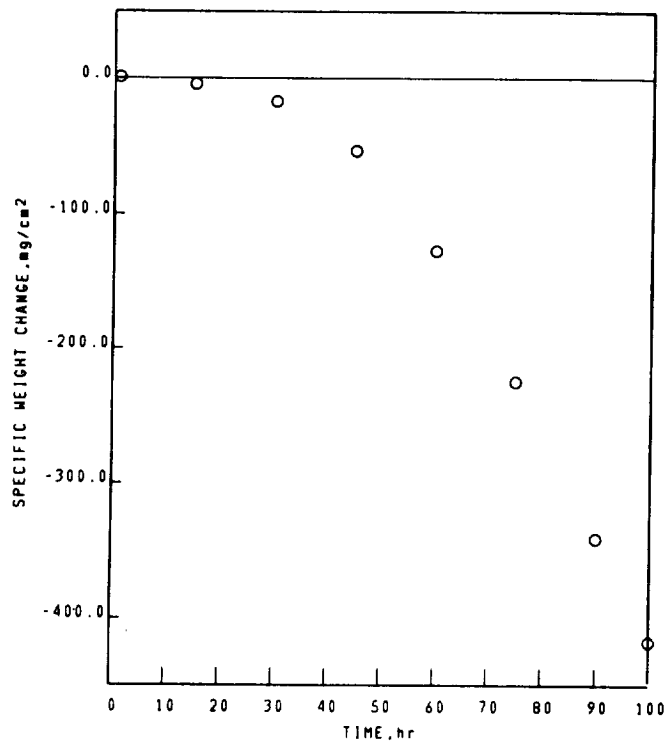
COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-003-127-1

IN-100

1150°C 1.00hr CYCLES 100.00hr TEST 12.700mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.63
15.00	-4.39
30.00	-17.33
45.00	-54.04
60.00	-127.53
75.00	-225.13
90.00	-340.24
100.00	-417.57

NI BASE
IN-100

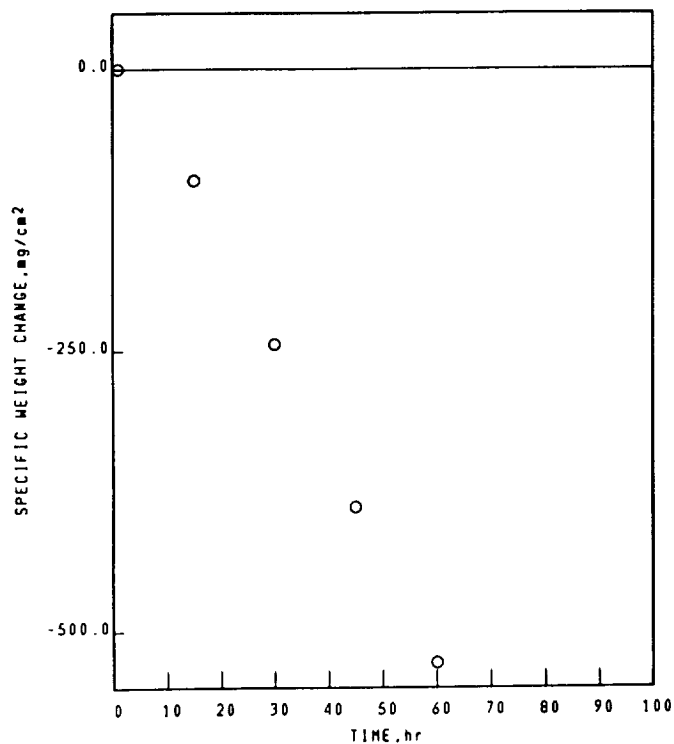
COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-003-127-2

1150°C 1.00hr CYCLES 60.00hr TEST 12.700mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.21
15.00	-97.62
30.00	-244.31
45.00	-388.61
60.00	-527.85

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

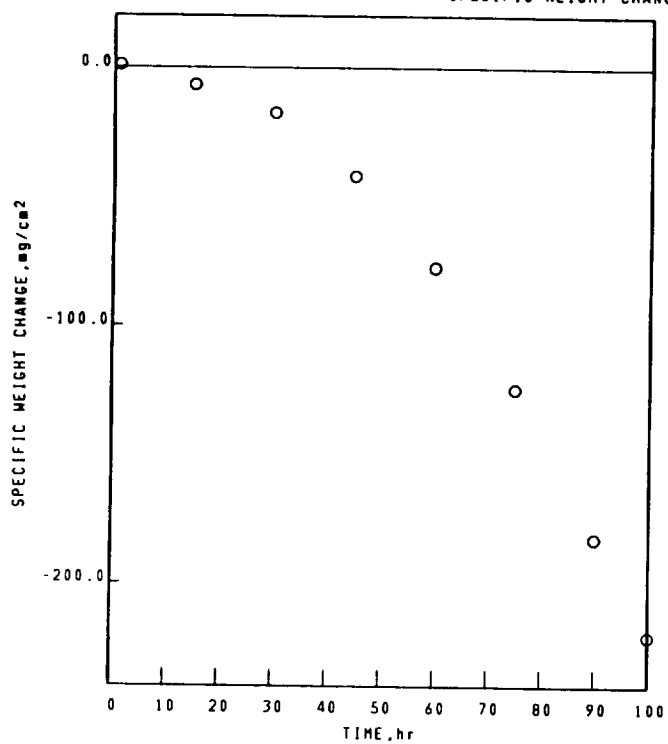
02-04-003-127-3

IN-100

1150°C 1.00hr CYCLES 100.00hr TEST 2.630mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.95
15.00	-6.73
30.00	-17.49
45.00	-42.23
60.00	-77.46
75.00	-124.49
90.00	-182.49
100.00	-220.17

NI BASE

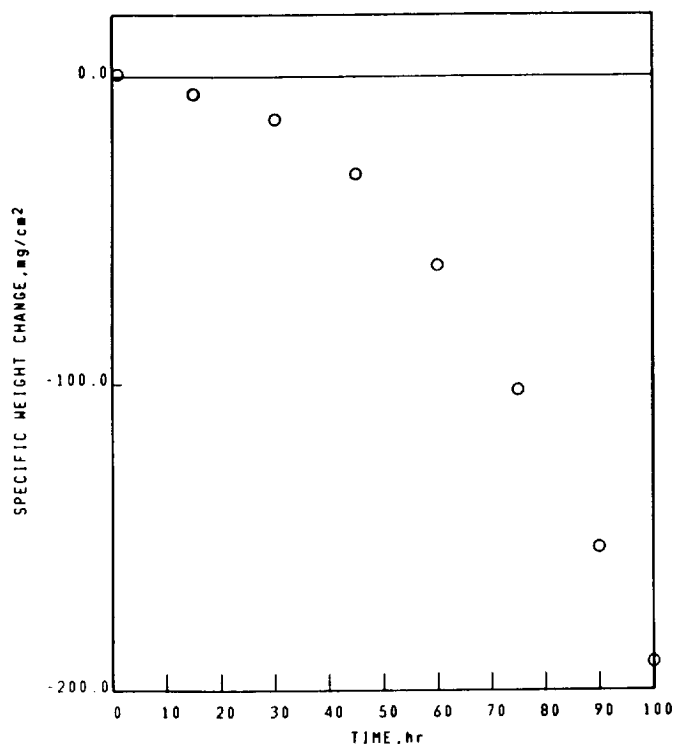
COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-003-127-4

IN-100

1150°C 1.00hr CYCLES 100.00hr TEST 2.637mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.74
15.00	-5.33
30.00	-13.61
45.00	-31.39
60.00	-61.49
75.00	-102.03
90.00	-153.57
100.00	-190.98

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-003-127-4

IN-100

1150°C 1.00hr CYCLES 100.00hr TEST 2.637mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

100 hr

STANDARD SURFACE

SPINEL, $a_0 = 8.10 \text{ \AA}$.

Al_2O_3

SPINEL, $a_0 = 8.25 \text{ \AA}$.

NiO

TRI(RUTILE), $d(110) \leq 3.30 \text{ \AA}$.

FACE CENTERED CUBIC MATRIX

SPALL

100 hr

COLLECTED SPALL

NiO

SPINEL, $a_0 = 8.30 \text{ \AA}$.

Ni(W,Mo)O_4 TYPE 2

NI BASE

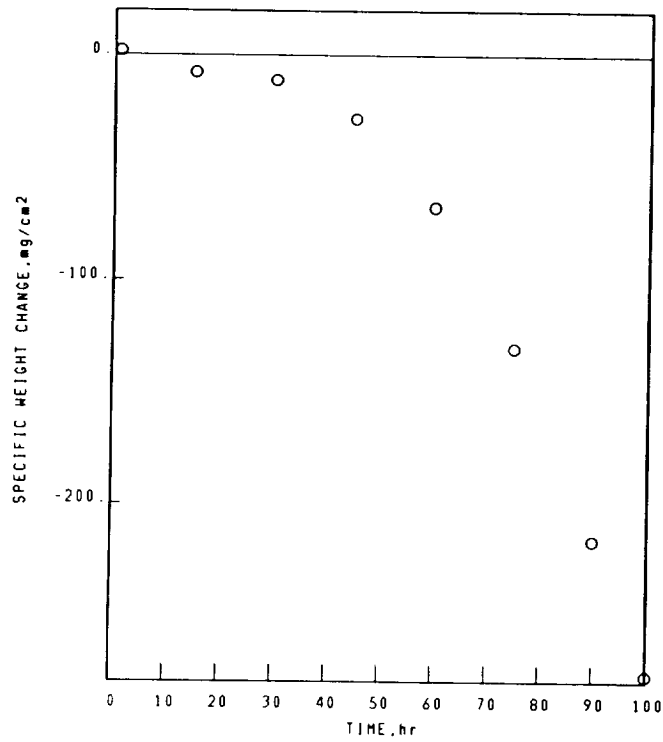
COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-003-127-5

IN-100

1150°C 1.00hr CYCLES 100.00hr TEST 3.251mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	1.84
15.00	-7.67
30.00	-11.34
45.00	-28.51
60.00	-67.52
75.00	-130.70
90.00	-216.31
100.00	-277.22

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-003-127-6

IN-100

1150°C

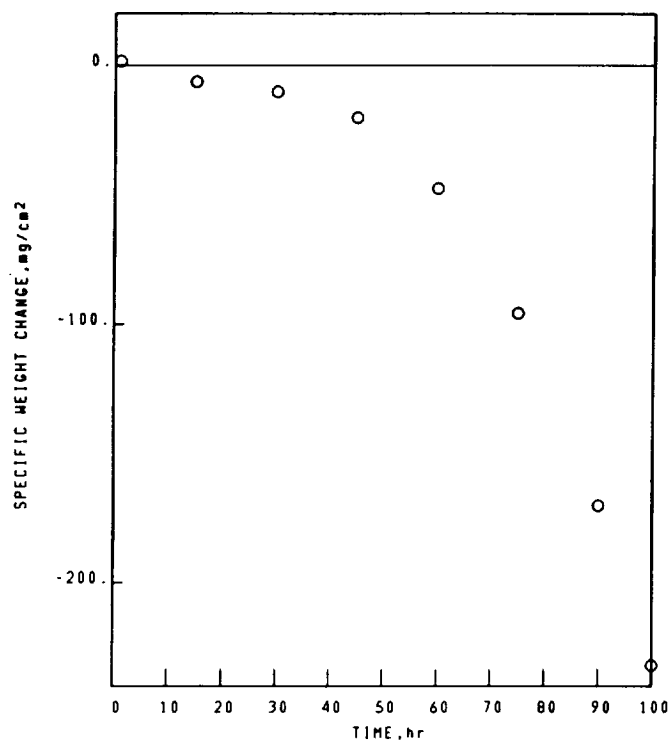
1.00hr CYCLES

100.00hr TEST

3.251mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	1.63
15.00	-6.32
30.00	-10.14
45.00	-20.18
60.00	-47.95
75.00	-95.89
90.00	-170.45
100.00	-231.93

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-003-096-3

IN-100

1093°C

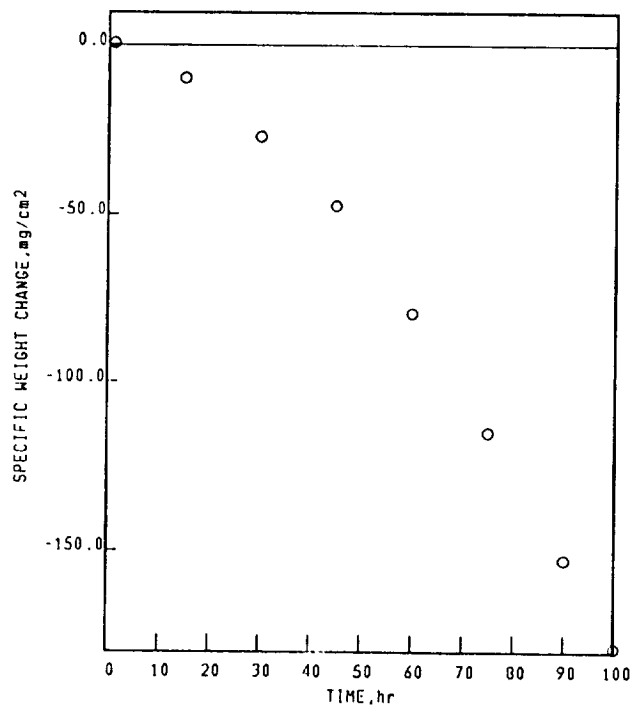
1.00hr CYCLES

100.00hr TEST

3.226mm THICK

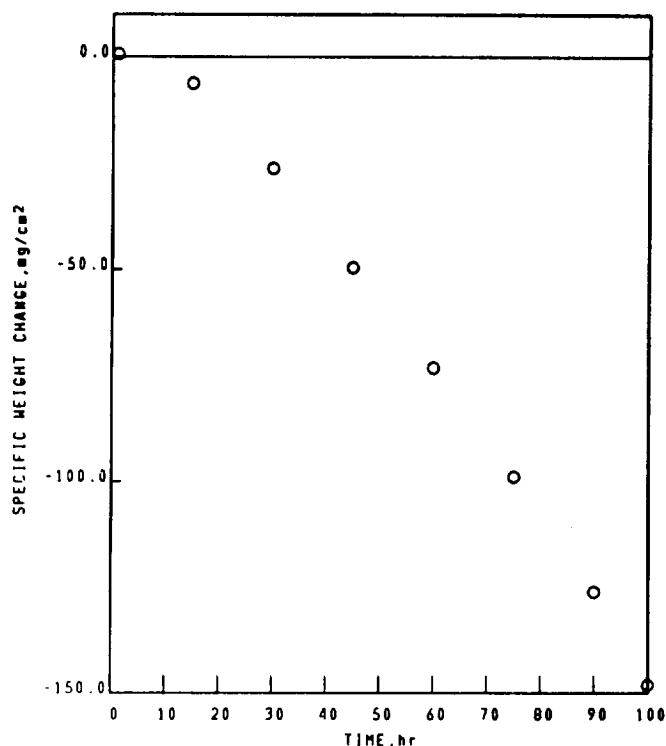
STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.57
15.00	-9.82
30.00	-26.92
45.00	-47.40
60.00	-79.62
75.00	-114.69
90.00	-152.60
100.00	-178.98

Ni BASE
 IN-100
 COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS
 1093°C 1.00hr CYCLES 100.00hr TEST 3.277mm THICK STATIC AIR
 02-04-003-096-6
 SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.60
15.00	-6.14
30.00	-26.03
45.00	-49.60
60.00	-73.34
75.00	-98.80
90.00	-126.26
100.00	-148.13

Ni BASE
 IN-100
 COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS
 1093°C 1.00hr CYCLES 100.00hr TEST 3.277mm THICK STATIC AIR
 02-04-003-096-6
 X-RAY DIFFRACTION DATA

SURFACE
 100 hr
 STANDARD SURFACE
 SPINEL, $a_0 = 0.408$ nm
 Cr₂O₃
 NiO
 FACE CENTERED CUBIC MATRIX

SPALL
 100 hr
 COLLECTED SPALL
 NiO
 SPINEL, $a_0 = 0.408$ nm
 Al₂O₃

NI BASE

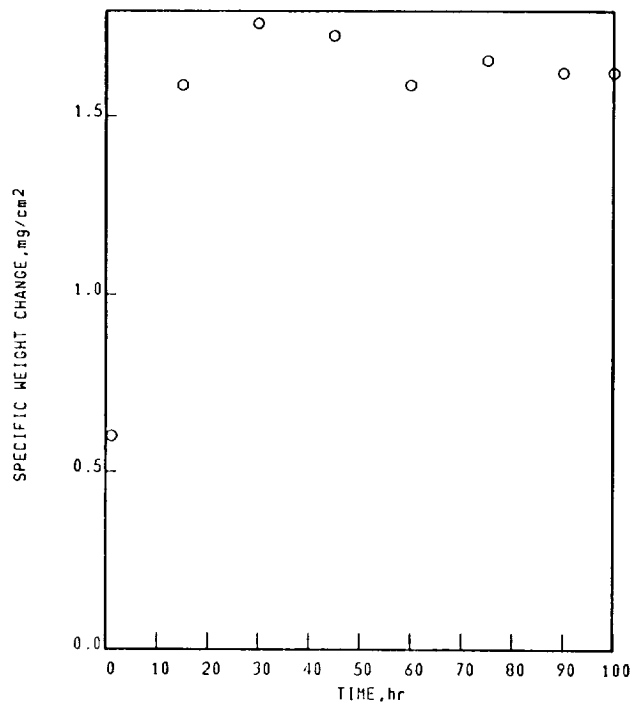
COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-003-098-3

IN-100

1038°C 1.00hr CYCLES 100.00hr TEST 3.251mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.60
15.00	1.59
30.00	1.76
45.00	1.73
60.00	1.59
75.00	1.66
90.00	1.62
100.00	1.62

Ni BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-003-098-6

IN-100

1038°C

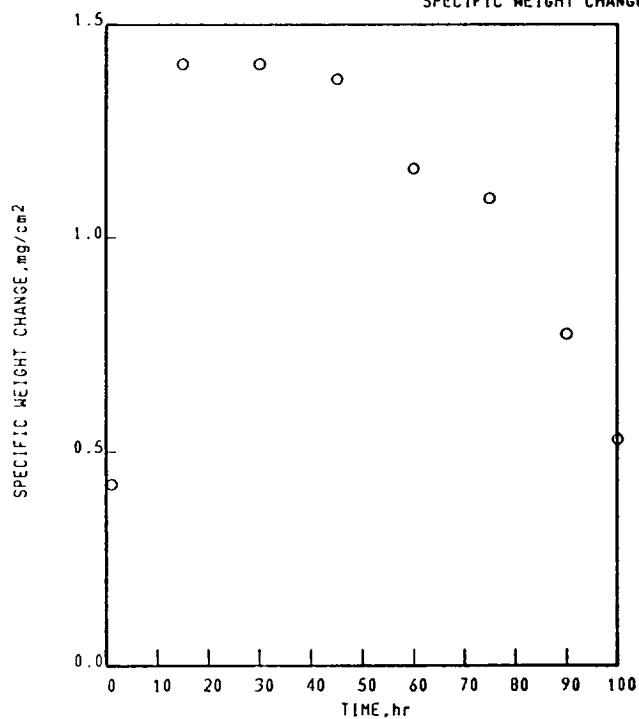
1.00hr CYCLES

100.00hr TEST

3.277mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.42
15.00	1.41
30.00	1.41
45.00	1.37
60.00	1.16
75.00	1.09
90.00	0.77
100.00	0.53

Ni BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-003-098-6

IN-100

1038°C

1.00hr CYCLES

100.00hr TEST

3.277mm THICK

STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

100 hr

STANDARD SURFACE

Cr₂O₃

FACE CENTERED CUBIC MATRIX

SPALL

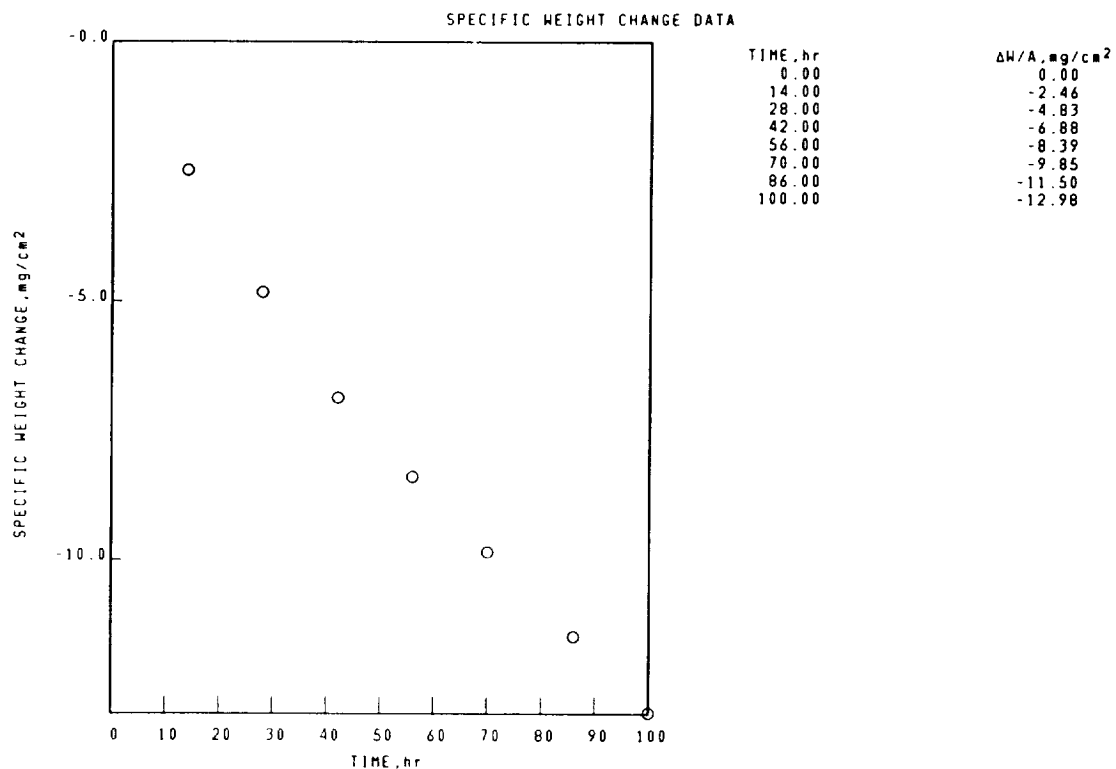
100 hr

COLLECTED SPALL

NiO

SPINEL, a₀=8.25Å.

Ni BASE COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS 02-04-004-041-4
 IN-713C 1150°C 1.00hr CYCLES 100.00hr TEST 6.500mm THICK STATIC AIR



Ni BASE COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS 02-04-004-041-4
 IN-713C 1150°C 1.00hr CYCLES 100.00hr TEST 6.500mm THICK STATIC AIR
X-RAY DIFFRACTION DATA

SURFACE 100 hr STANDARD SURFACE SPINEL, $a_0 = 8.15 \text{ \AA}$. TRI(RUTILE), $d(110) \leq 3.30 \text{ \AA}$. FACE CENTERED CUBIC MATRIX	SPALL 100 hr COLLECTED SPALL NiO TRI(RUTILE), $d(110) \leq 3.30 \text{ \AA}$. SPINEL, $a_0 = 8.20 \text{ \AA}$. Cr ₂ O ₃ Al ₂ O ₃
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NI BASE

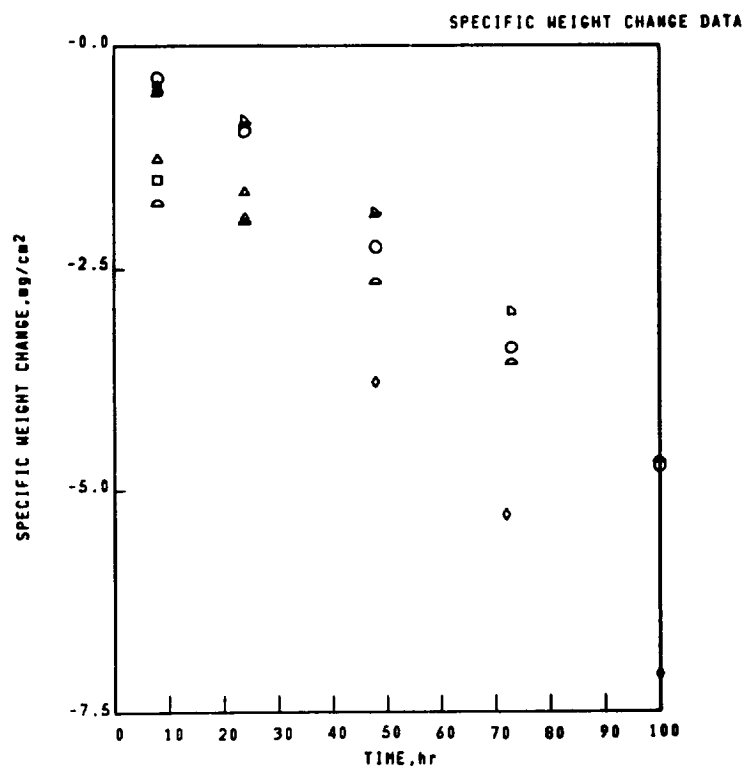
COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-004-003-6

IN-713C

1100°C 1.00hr CYCLES 100.00hr TEST 6.500mm THICK

STATIC AIR(TN D-7484)



○ 02-04-004-003-6
 □ 02-04-004-003-1
 △ 02-04-004-003-2
 ▽ 02-04-004-003-3
 ◇ 02-04-004-003-4
 ◐ 02-04-004-003-5
 ◑ 02-04-004-010-1

TIME, hr	ΔW/A, mg/cm ²
0.00	0.00
8.00	-0.36
24.00	-0.97
48.00	-2.27
73.00	-3.40
100.00	-4.74
TIME, hr	ΔW/A, mg/cm ² 003-1
0.00	0.00
8.00	-1.51
TIME, hr	ΔW/A, mg/cm ² 003-2
0.00	0.00
8.00	-1.27
24.00	-1.65
TIME, hr	ΔW/A, mg/cm ² 003-3
0.00	0.00
8.00	-0.54
24.00	-0.88
48.00	-1.91
TIME, hr	ΔW/A, mg/cm ² 003-4
0.00	0.00
8.00	-0.49
24.00	-0.85
48.00	-1.89
73.00	-3.00
TIME, hr	ΔW/A, mg/cm ² 003-5
0.00	0.00
8.00	-1.77
24.00	-1.98
48.00	-2.64
73.00	-3.56
100.00	-4.67
TIME, hr	ΔW/A, mg/cm ² 010-1
0.00	0.00
8.00	-0.46
24.00	-1.94
48.00	-3.78
72.00	-5.29
100.00	-7.07

X-RAY DIFFRACTION DATA

SURFACE
 8 hr
 STANDARD SURFACE
 TRI(RUTILE), d(110) ≤ 3.30Å.
 Al₂O₃
 Cr₂O₃
 FACE CENTERED CUBIC MATRIX

SPALL
 8 hr
 NO SIGNIFICANT SPALL OBSERVED

003-1

X-RAY DIFFRACTION DATA

SURFACE
 100 hr
 STANDARD SURFACE
 Al₂O₃
 TRI(RUTILE), d(110) ≤ 3.30Å.
 FACE CENTERED CUBIC MATRIX

SPALL
 100 hr
 COLLECTED SPALL
 SPINEL, a₀ = 0.25Å.
 NiO
 Al₂O₃

003-5

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-004-007-6

IN-713C

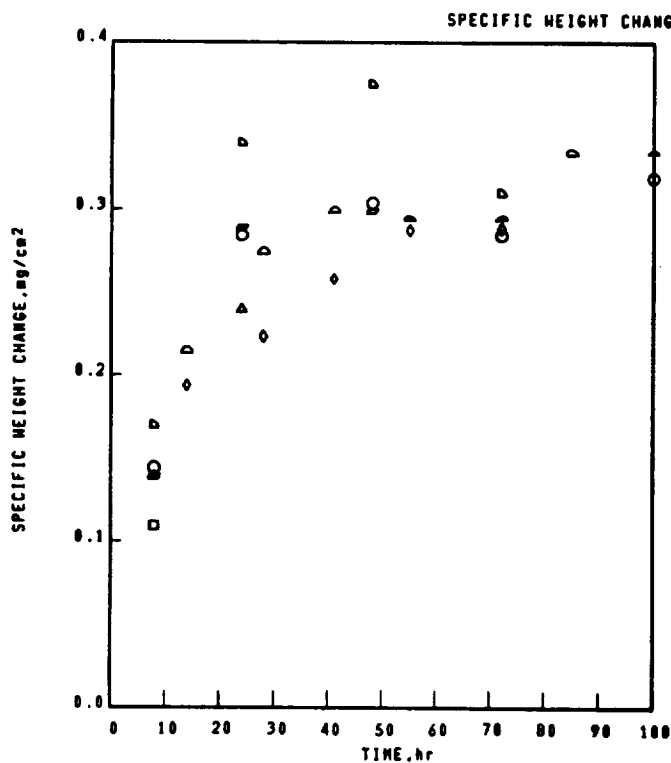
1000°C

1.00hr CYCLES

100.00hr TEST

6.500mm THICK

STATIC AIR(TN D-7404)



TIME,hr	ΔW/A,mg/cm²
0.00	0.00
0.00	0.14
24.00	0.20
40.00	0.30
72.00	0.20
100.00	0.32

TIME,hr	ΔW/A,mg/cm² 007-1
0.00	0.00
0.00	0.11

TIME,hr	ΔW/A,mg/cm² 007-2
0.00	0.00
0.00	0.14
24.00	0.24

TIME,hr	ΔW/A,mg/cm² 007-3
0.00	0.00
0.00	0.14
24.00	0.29
40.00	0.30

TIME,hr	ΔW/A,mg/cm² 007-4
0.00	0.00
0.00	0.17
24.00	0.34
40.00	0.37
72.00	0.31

TIME,hr	ΔW/A,mg/cm² 009-4
0.00	0.00
14.00	0.22
20.00	0.20
41.00	0.30
72.00	0.30
100.00	0.34
55.00	0.30
85.00	0.34

TIME,hr	ΔW/A,mg/cm² 009-5
0.00	0.00
14.00	0.19
20.00	0.22
41.00	0.26
72.00	0.29
55.00	0.29

X-RAY DIFFRACTION DATA

SURFACE

0 hr

STANDARD SURFACE

Al₂O₃

TRT(RUTILE), d(110) ≤ 3.30Å.

FACE CENTERED CUBIC MATRIX

SPALL

0 hr

NO SIGNIFICANT SPALL OBSERVED

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-005-041-2

IN-738

1150°C

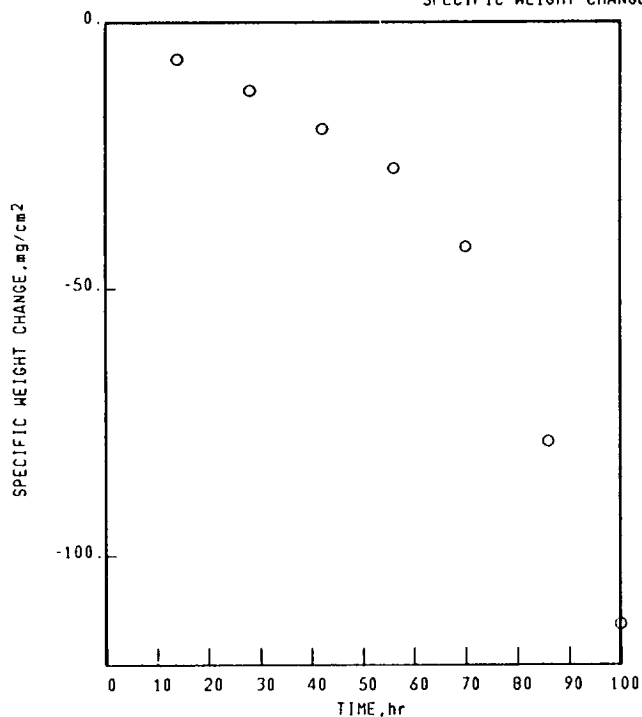
1.00hr CYCLES

100.00hr TEST

6.500mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr
0.00
14.00
28.00
42.00
56.00
70.00
86.00
100.00

ΔW/A, mg/cm²
0.00
-6.81
-12.70
-19.92
-27.31
-42.21
-78.39
-112.61

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-005-041-2

IN-738

1150°C

1.00hr CYCLES

100.00hr TEST

6.500mm THICK

STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

100 hr

STANDARD SURFACE

NiO

SPINEL, $a_0 = 8.30 \text{ \AA}$.

Cr₂O₃

SPALL

100 hr

COLLECTED SPALL

NiO

SPINEL, $a_0 = 8.30 \text{ \AA}$.

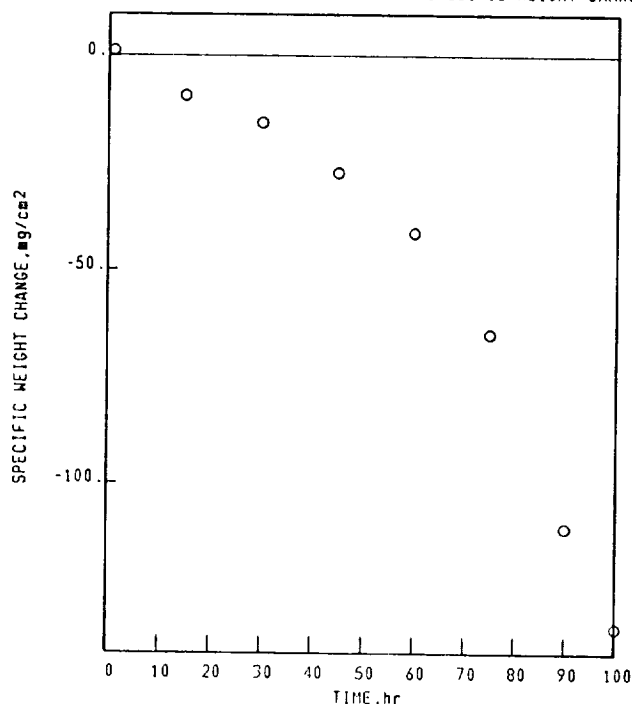
NI BASE
IN-738

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-005-321-1

1150°C 1.00hr CYCLES 100.00hr TEST 2.321mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	1.12
15.00	-9.45
30.00	-15.73
45.00	-27.21
60.00	-41.31
75.00	-65.26
90.00	-110.41
100.00	-134.14

NI BASE
IN-738

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-005-321-1

1150°C 1.00hr CYCLES 100.00hr TEST 2.321mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE
100 hr
STANDARD SURFACE
NiO
SPINEL, $a_0=8.30\text{\AA}$.
Cr₂O₃
TRT(RUTILE), $d(110)\leq 3.30\text{\AA}$.
NiTiO₃
Ni(H,Mo)O₄ TYPE 2

SPALL
100 hr
COLLECTED SPALL
NiO
SPINEL, $a_0=8.30\text{\AA}$.
TRT(RUTILE), $d(110)\leq 3.30\text{\AA}$.
Cr₂O₃
NiTiO₃
UNKNOWN LINES, d VALUES

NI BASE

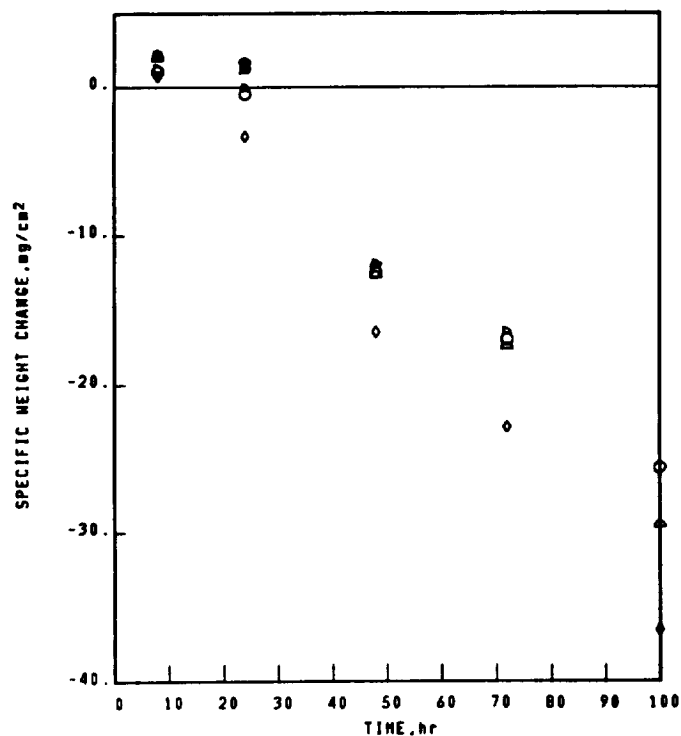
COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-005-004-6

IN-730

1100°C 1.00hr CYCLES 100.00hr TEST 6.500mm THICK STATIC AIR(TN D-7404)

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔH/A, mg/cm²
0.00	0.00
8.00	1.00
24.00	-0.45
48.00	-12.49
72.00	-16.94
100.00	-25.66

TIME, hr	ΔH/A, mg/cm² 004-1
0.00	0.00
8.00	2.16

TIME, hr	ΔH/A, mg/cm² 004-2
0.00	0.00
8.00	2.16
24.00	1.55

TIME, hr	ΔH/A, mg/cm² 004-3
0.00	0.00
8.00	1.97
24.00	1.09
48.00	-11.99

TIME, hr	ΔH/A, mg/cm² 004-4
0.00	0.00
8.00	1.17
24.00	-0.89
48.00	-11.95
72.00	-16.40

TIME, hr	ΔH/A, mg/cm² 004-5
0.00	0.00
8.00	1.97
24.00	1.00
48.00	-12.63
72.00	-17.39
100.00	-29.46

TIME, hr	ΔH/A, mg/cm² 010-6
0.00	0.00
8.00	0.76
24.00	-3.33
48.00	-14.41
72.00	-22.05
100.00	-36.52

X-RAY DIFFRACTION DATA

SURFACE

8 hr

STANDARD SURFACE

Cr₂O₃

TRI(RUTILE), d(110) ≤ 3.30A.

FACE CENTERED CUBIC MATRIX

SPALL

8 hr

NO SIGNIFICANT SPALL OBSERVED

004-1

X-RAY DIFFRACTION DATA

SURFACE

100 hr

STANDARD SURFACE

Cr₂O₃SPINEL, $\theta_0 = 0.25A$.

TRI(RUTILE), d(110) ≤ 3.30A.

FACE CENTERED CUBIC MATRIX

SPALL

100 hr

COLLECTED SPALL

Cr₂O₃

TRI(RUTILE), d(110) ≤ 3.30A.

NiO

SPINEL, $\theta_0 = 0.25A$.

004-5

Ni BASE

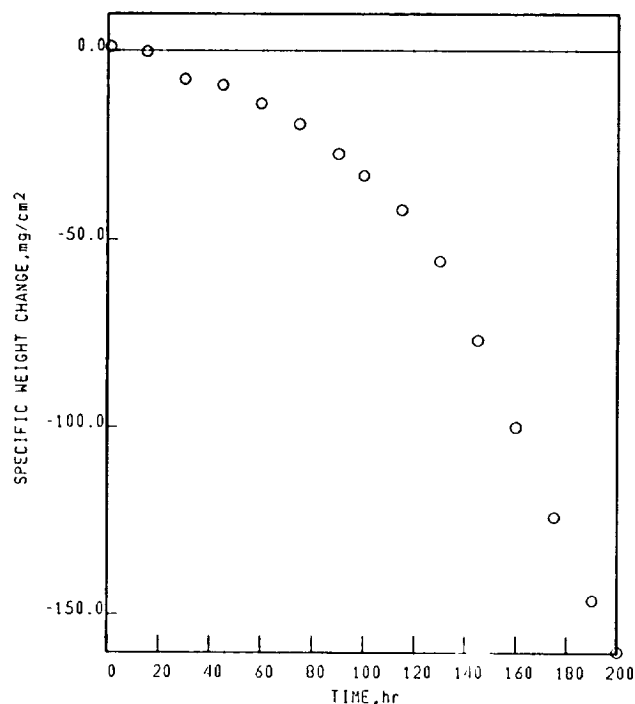
COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-005-324-1

IN-738

1100°C 1.00hr CYCLES 200.00hr TEST 2.330mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.98
15.00	-0.26
30.00	-7.66
45.00	-9.20
60.02	-14.08
75.00	-19.56
90.00	-27.20
100.00	-32.99
115.00	-42.11
130.00	-55.81
145.00	-77.00
160.00	-99.93
175.00	-123.82
190.00	-146.16
200.00	-159.84

Ni BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-005-324-1

IN-738

1100°C 1.00hr CYCLES 200.00hr TEST 2.330mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE
200 hr
STANDARD SURFACE
NiO
SPINEL, $a_0=8.30\text{\AA}$.
 Cr_2O_3
 $\text{Ti}(\text{RUTILE}), d(110)\leq 3.30\text{\AA}$.
 NiTiO_3
UNKNOWN LINES, d VALUES
2.88\AA.
FACE CENTERED CUBIC MATRIX

SPALL
200 hr
COLLECTED SPALL
NiO
SPINEL, $a_0=8.30\text{\AA}$.
 $\text{Ti}(\text{RUTILE}), d(110)\leq 3.30\text{\AA}$.
 Cr_2O_3
 NiTiO_3
 Al_2O_3
UNKNOWN LINES, d VALUES
2.90\AA.

NI BASE

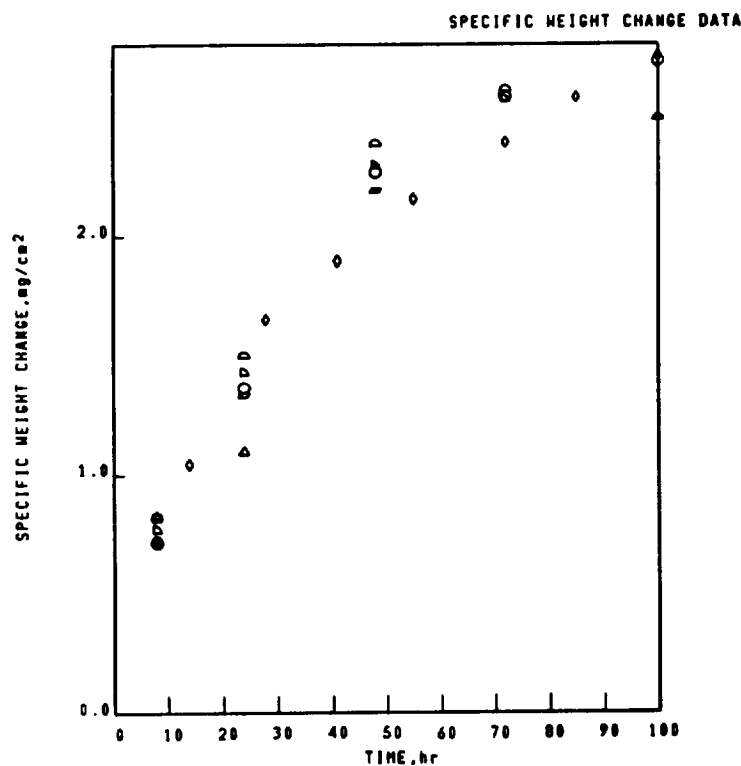
COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-005-000-6

IN-730

1000°C 1.00hr CYCLES 100.00hr TEST 6.500mm THICK

STATIC AIR(TN D-7484)



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
8.00	0.72
24.00	1.37
48.00	2.27
72.00	2.58
100.00	2.73

TIME, hr	ΔW/A, mg/cm² 000-1
0.00	0.00
8.00	0.02

TIME, hr	ΔW/A, mg/cm² 000-2
0.00	0.00
8.00	0.02
24.00	1.10

TIME, hr	ΔW/A, mg/cm² 000-3
0.00	0.00
8.00	0.72
24.00	1.33
48.00	2.19

TIME, hr	ΔW/A, mg/cm² 000-4
0.00	0.00
8.00	0.77
24.00	1.43
48.00	2.29
72.00	2.57

TIME, hr	ΔW/A, mg/cm² 000-5
0.00	0.00
8.00	0.02
24.00	1.50
48.00	2.39
72.00	2.62
100.00	2.49

TIME, hr	ΔW/A, mg/cm² 009-3
0.00	0.00
14.00	1.04
20.00	1.65
41.00	1.90
72.00	2.39
100.00	2.75
55.00	2.15
85.00	2.50

X-RAY DIFFRACTION DATA

SURFACE
8 hr
STANDARD SURFACE
Cr₂O₃
TRT(RUTILE), d(110) ≤ 3.30A.
FACE CENTERED CUBIC MATRIX

SPALL
8 hr
NO SIGNIFICANT SPALL OBSERVED

000-1

X-RAY DIFFRACTION DATA

SURFACE
100 hr
STANDARD SURFACE
Cr₂O₃
TRT(RUTILE), d(110) ≤ 3.30A.
FACE CENTERED CUBIC MATRIX

SPALL
100 hr
NO SIGNIFICANT SPALL OBSERVED

000-5

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-007-323-2

IN-792-Hf

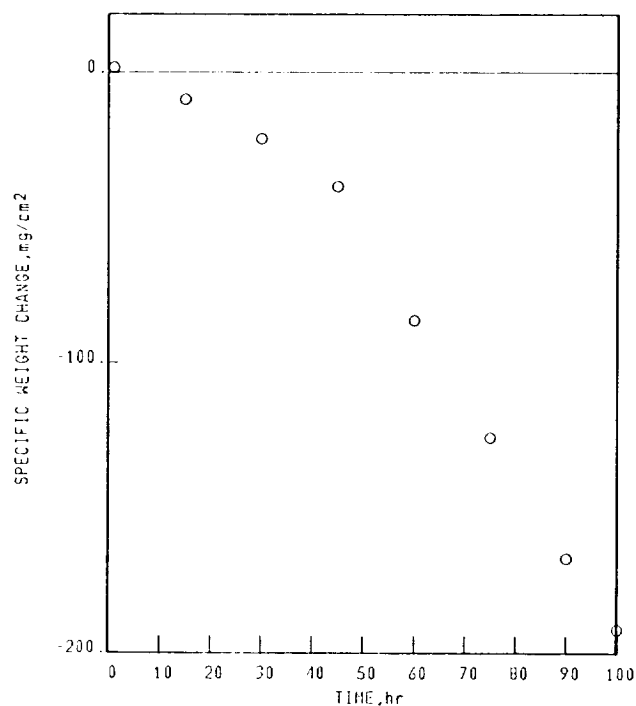
1150°C

1.00hr CYCLES

100.00hr TEST 2.316mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	1.50
15.00	-9.27
30.00	-22.74
45.00	-39.28
60.00	-85.60
75.00	-125.66
90.00	-167.49
100.00	-192.13

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-007-323-2

IN-792-Hf

1150°C

1.00hr CYCLES

100.00hr TEST 2.316mm THICK

STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

100 hr

STANDARD SURFACE

NiO

SPINEL, $a_0 = 0.30\text{Å}$.

Cr₂O₃

NiTiO₃

TRI(RUTILE), $d(110) \leq 3.30\text{Å}$.

Ni(W,Mo)O₄ TYPE 1

FACE CENTERED CUBIC MATRIX

SPALL

100 hr

COLLECTED SPALL

NiO

SPINEL, $a_0 = 0.30\text{Å}$.

Ni(W,Mo)O₄ TYPE 1

TRI(RUTILE), $d(110) \leq 3.30\text{Å}$.

Cr₂O₃

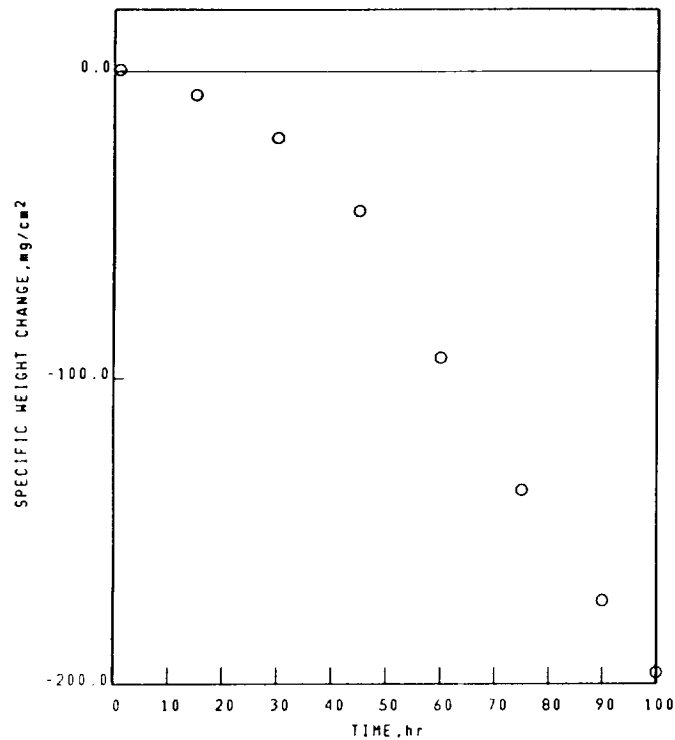
Ni BASE
IN-792-Hf

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-007-323-5

1150°C 1.00hr CYCLES 100.00hr TEST 2.236mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.52
15.00	-7.56
30.00	-21.57
45.00	-45.61
60.00	-93.33
75.00	-136.90
90.00	-172.67
100.00	-196.23

Ni BASE
IN-792-Hf

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-007-323-5

1150°C 1.00hr CYCLES 100.00hr TEST 2.236mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE
100 hr
STANDARD SURFACE
SPINEL, $a_0=8.30\text{\AA}$.
NiO
Ni(W,Mo)O₄ TYPE 1
TRI(RUTILE), $d(110)\leq 3.30\text{\AA}$.
Cr₂O₃
FACE CENTERED CUBIC MATRIX

SPALL
100 hr
PROBABLE CROSS-SPALL
NiO
SPINEL, $a_0=8.30\text{\AA}$.
Ni(W,Mo)O₄ TYPE 1
TRI(RUTILE), $d(110)\leq 3.30\text{\AA}$.
CoO
Ni(W,Mo)O₄ TYPE 2

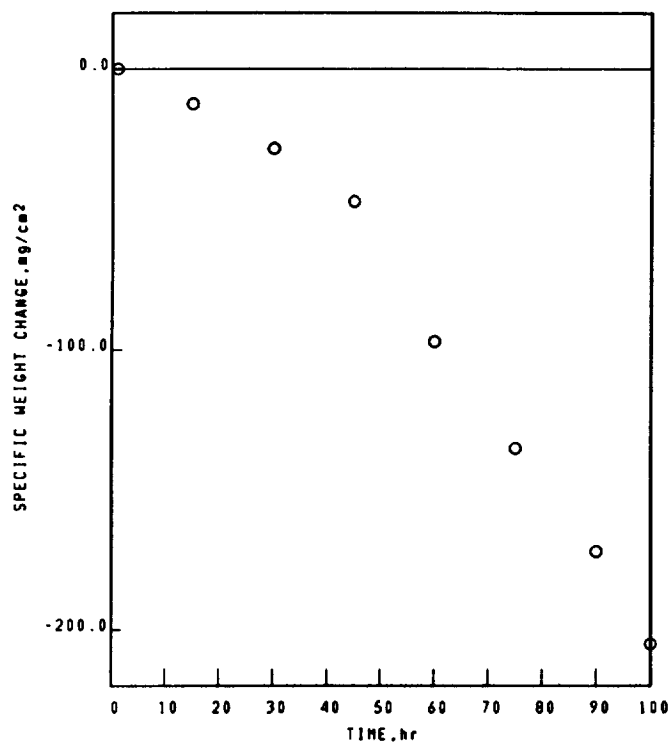
NI BASE
IN-792-Hf

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-007-337-5

1150°C 1.00hr CYCLES 100.00hr TEST 2.322mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.08
15.00	-12.32
30.00	-27.79
45.00	-46.69
60.00	-97.05
75.00	-134.85
90.00	-171.67
100.00	-204.98

NI BASE
IN-792-Hf

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-007-337-5

1150°C 1.00hr CYCLES 100.00hr TEST 2.322mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

100 hr

STANDARD SURFACE

SPINEL, $a_0 = 8.25\text{\AA}$.

NiO

TRI(RUTILE), $d(110) \leq 3.30\text{\AA}$.

Cr₂O₃

(Ni,Co,Fe)TiO₃

Ni(W,Mo)O₄ TYPE 1

FACE CENTERED CUBIC MATRIX

SPALL

100 hr

COLLECTED SPALL

NiO

SPINEL, $a_0 = 8.30\text{\AA}$.

TRI(RUTILE), $d(110) \leq 3.30\text{\AA}$.

Ni(W,Mo)O₄ TYPE 1

Ni(W,Mo)O₄ TYPE 2

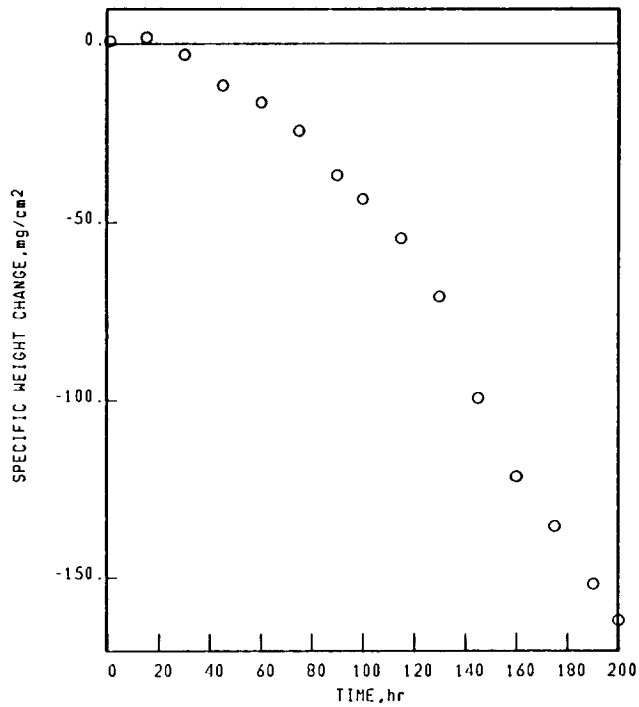
Ni BASE
IN-792+Hf

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-007-310-2

1100°C 1.00hr CYCLES 200.00hr TEST 2.302mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.77
15.00	1.78
30.00	-3.03
45.00	-11.40
60.00	-16.19
75.00	-24.17
90.00	-36.63
100.00	-43.39
115.00	-54.57
130.00	-71.02
145.00	-99.26
160.00	-121.44
175.00	-135.43
190.00	-151.70
200.00	-161.87

Ni BASE
IN-792+Hf

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-007-310-2

1100°C 1.00hr CYCLES 200.00hr TEST 2.302mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE
200 hr
STANDARD SURFACE
NiO
SPINEL, $a_0=8.30\text{\AA}$.
TRI(RUTILE), $d(110)\leq 3.30\text{\AA}$.
Ni(W,Mo)O₄ TYPE 1

SPALL
200 hr
COLLECTED SPALL
NiO
Ni(W,Mo)O₄ TYPE 1
SPINEL, $a_0=8.25\text{\AA}$.
TRI(RUTILE), $d(110)\leq 3.30\text{\AA}$.

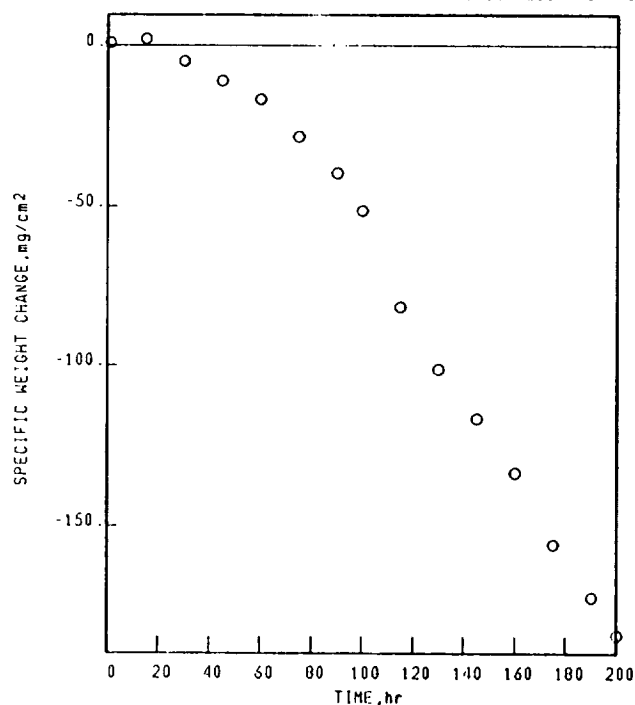
Ni BASE
IN-792+Hf

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-007-326-2

1100°C 1.00hr CYCLES 200.00hr TEST 2.315mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.86
15.00	2.13
30.00	-4.92
45.00	-11.06
60.00	-16.81
75.00	-28.50
90.00	-39.74
100.00	-51.39
115.00	-81.56
130.00	-101.25
145.00	-116.64
160.00	-133.39
175.00	-155.77
190.00	-172.59
200.00	-184.46

Ni BASE
IN-792+Hf

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-007-326-2

1100°C 1.00hr CYCLES 200.00hr TEST 2.315mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE
200 hr
STANDARD SURFACE
NiO
SPINEL, $a_0 = 0.30A$.
Cr₂O₃
NiTiO₃
TRI(RUTILE), $d(110) \leq 3.30A$.
FACE CENTERED CUBIC MATRIX

SPALL
200 hr
COLLECTED SPALL
NiO
SPINEL, $a_0 = 0.30A$.
TRI(RUTILE), $d(110) \leq 3.30A$.
Ni(W,Mo)O₄ TYPE 1
NiTiO₃
Cr₂O₃
UNKNOWN LINES, d VALUES
3.10A.

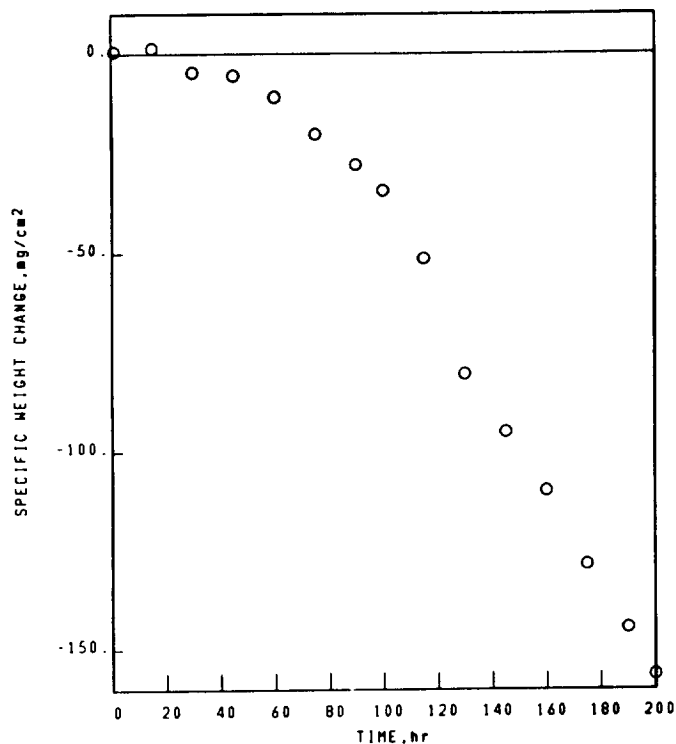
NI BASE
IN-792-Hf

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-007-326-5

1100°C 1.00hr CYCLES 200.00hr TEST 2.306mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.61
15.00	1.46
30.00	-4.58
45.00	-5.35
60.00	-10.61
75.00	-19.94
90.00	-27.62
100.00	-34.19
115.00	-51.50
130.00	-80.65
145.00	-95.00
160.00	-109.95
175.00	-128.61
190.00	-144.60
200.00	-156.26

NI BASE
IN-792-Hf

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-007-326-5

1100°C 1.00hr CYCLES 200.00hr TEST 2.306mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE
200 hr
STANDARD SURFACE
NiO
SPINEL, $a_0=8.30\text{\AA}$.
 Al_2TiO_5
SPINEL, $a_0=8.10\text{\AA}$.
 Cr_2O_3
 $\text{Ni}(\text{W},\text{Mo})\text{O}_4$ TYPE 2
FACE CENTERED CUBIC MATRIX

SPALL
200 hr
COLLECTED SPALL
NiO
SPINEL, $a_0=8.30\text{\AA}$.
 $\text{Ni}(\text{W},\text{Mo})\text{O}_4$ TYPE 1
 $\text{Ti}(\text{RUTILE})$, $d(110)\leq 3.30\text{\AA}$.
 $(\text{Ni},\text{Co},\text{Fe})\text{TiO}_3$
 Cr_2O_3
UNKNOWN LINES, d VALUES
2.81Å.
2.76Å.

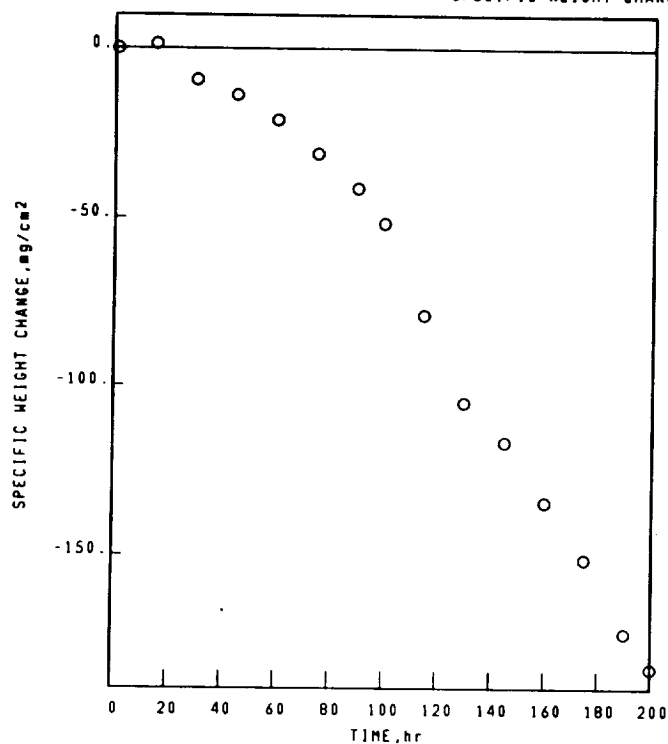
NI BASE
IN-792-Hf

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-007-336-5

1100°C 1.00hr CYCLES 200.00hr TEST 2.306mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.00
15.00	1.36
30.00	-9.31
45.00	-13.80
60.00	-21.27
75.00	-31.24
90.00	-41.50
100.00	-51.69
115.00	-78.01
130.00	-105.17
145.00	-116.84
160.00	-134.69
175.00	-151.17
190.00	-173.42
200.00	-183.99

NI BASE
IN-792-Hf

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-007-336-5

1100°C 1.00hr CYCLES 200.00hr TEST 2.306mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

200 hr

STANDARD SURFACE

NiO

SPINEL, $a_0=8.30\text{\AA}$.

TRI(RUTILE), $d(110)\leq 3.30\text{\AA}$.

Cr₂O₃

(Ni,Co,Fe)TiO₃

TRI(RUTILE), $d(110)\leq 3.30\text{\AA}$.

Ni(W,Mo)O₄ TYPE 2

FACE CENTERED CUBIC MATRIX

SPALL

200 hr

COLLECTED SPALL

NiO

SPINEL, $a_0=8.30\text{\AA}$.

Ni(W,Mo)O₄ TYPE 1

TRI(RUTILE), $d(110)\leq 3.30\text{\AA}$.

Ni BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-031-328-3

IN-939

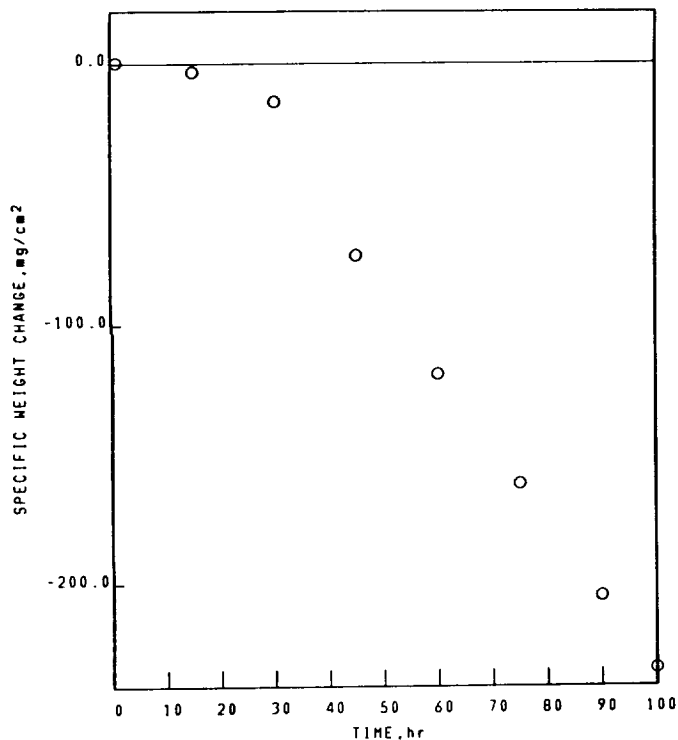
1150°C

1.00hr CYCLES

100.00hr TEST 2.310mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.43
15.00	-3.14
30.00	-14.44
45.00	-73.87
60.00	-119.21
75.00	-161.99
90.00	-205.15
100.00	-233.19

Ni BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-031-328-3

IN-939

1150°C

1.00hr CYCLES

100.00hr TEST 2.310mm THICK

STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

100 hr

STANDARD SURFACE

NiO

Cr₂O₃SPINEL, $a_0 = 8.30 \text{ \AA}$.TRI(RUTILE), $d(110) \leq 3.30 \text{ \AA}$.

FACE CENTERED CUBIC MATRIX

SPALL

100 hr

COLLECTED SPALL

NiO

SPINEL, $a_0 = 8.30 \text{ \AA}$.Cr₂O₃TRI(RUTILE), $d(110) \leq 3.30 \text{ \AA}$.SPINEL, $a_0 = 8.10 \text{ \AA}$.

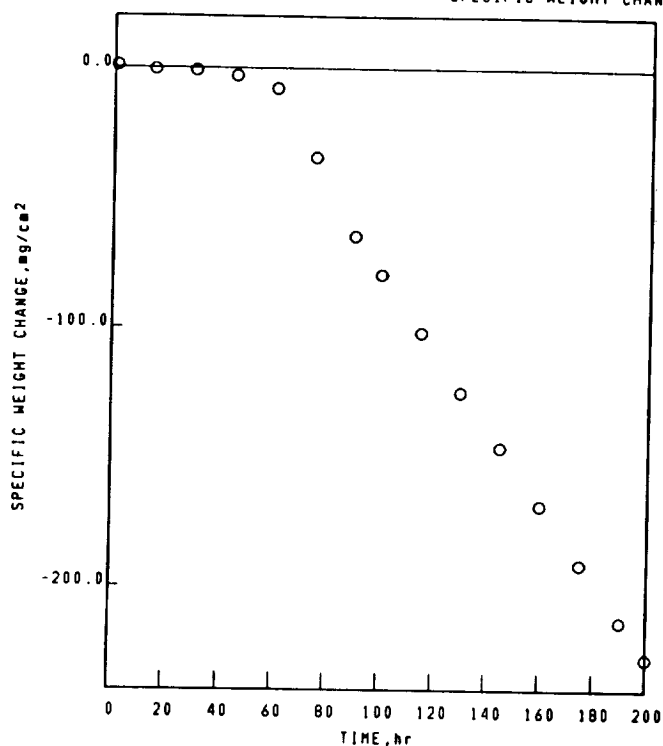
NI BASE
IN-939

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-031-327-3

1100°C 1.00hr CYCLES 200.00hr TEST 2.304mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.87
15.00	-0.59
30.00	-0.98
45.00	-2.90
60.00	-7.79
75.00	-33.99
90.00	-64.38
100.00	-79.36
115.00	-101.91
130.00	-124.90
145.00	-145.71
160.00	-168.06
175.00	-191.10
190.00	-213.46
200.00	-227.66

NI BASE
IN-939

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-031-327-3

1100°C 1.00hr CYCLES 200.00hr TEST 2.304mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE
200 hr
STANDARD SURFACE
NiO
SPINEL, $a_0=8.30\text{\AA}$.
 Cr_2O_3
TRI(RUTILE), $d(110)\leq 3.30\text{\AA}$.
FACE CENTERED CUBIC MATRIX

SPALL
200 hr
COLLECTED SPALL
NiO
SPINEL, $a_0=8.30\text{\AA}$.
 Cr_2O_3
TRI(RUTILE), $d(110)\leq 3.30\text{\AA}$.
SPINEL, $a_0=8.05\text{\AA}$.

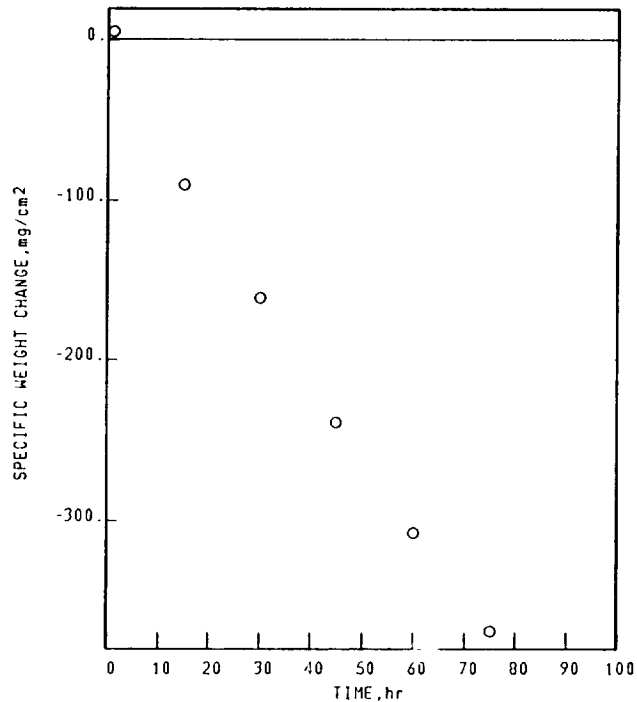
NI BASE
MAR-M-200

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-008-225-1

1150°C 1.00hr CYCLES 75.00hr TEST 2.157mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	5.12
15.00	-90.82
30.00	-161.07
45.00	-239.26
60.00	-307.63
75.00	-369.16

NI BASE
MAR-M-200

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-008-225-1

1150°C 1.00hr CYCLES 75.00hr TEST 2.157mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE
75 hr
STANDARD SURFACE
NiO
Ni(W,Mo)O₄ TYPE 1
SPINEL, a₀=8.10Å.
SPINEL, a₀=8.25Å.
TRI(RUTILE), d(110)≤3.30Å.

SPALL
75 hr
COLLECTED SPALL
NiO
Ni(W,Mo)O₄ TYPE 1
SPINEL, a₀=8.25Å.
TRI(RUTILE), d(110)≤3.30Å.

FACE CENTERED CUBIC MATRIX

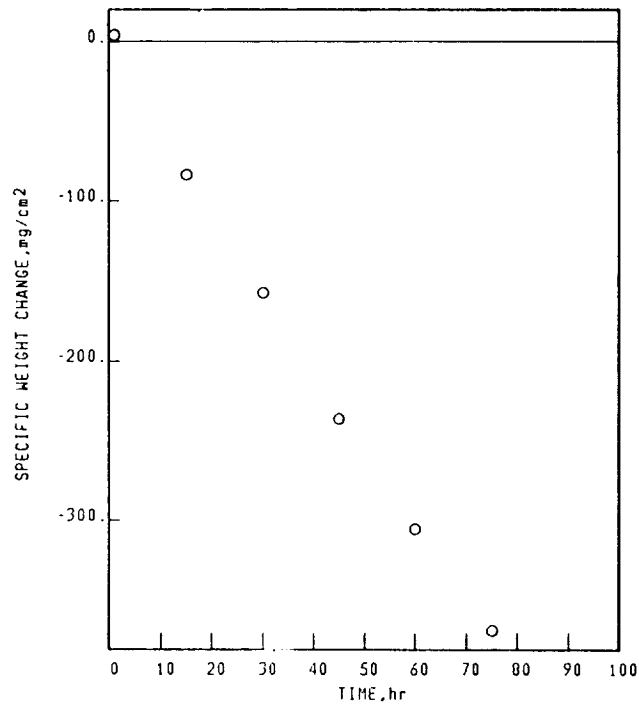
NI BASE
MAR-M-200

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-008-225-2

1150°C 1.00hr CYCLES 75.00hr TEST 2.155mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	4.02
15.00	-83.62
30.00	-157.55
45.00	-235.95
60.00	-305.41
75.00	-368.19

NI BASE
MAR-M-200

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-008-225-2

1150°C 1.00hr CYCLES 75.00hr TEST 2.155mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE
75 hr
STANDARD SURFACE
NiO
Ni(W,Mo)O₄ TYPE 1
SPINEL, a₀=8.10Å.
SPINEL, a₀=8.25Å.
TRI(RUTILE), d(110)≤3.30Å.

SPALL
75 hr
COLLECTED SPALL
NiO
Ni(W,Mo)O₄ TYPE 1
SPINEL, a₀=8.25Å.
TRI(RUTILE), d(110)≤3.30Å.

FACE CENTERED CUBIC MATRIX

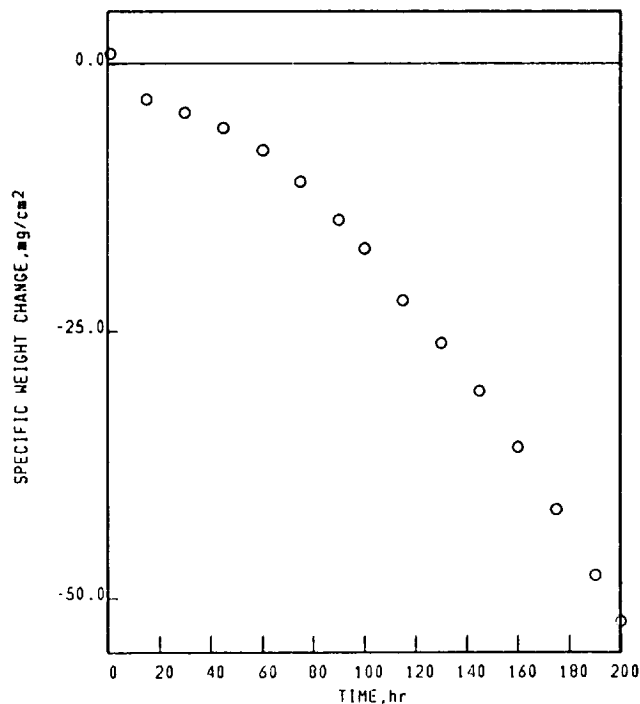
Ni BASE
MAR-M-200

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-008-310-3

1100°C 1.00hr CYCLES 200.00hr TEST 2.297mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.95
15.00	-3.31
30.00	-4.58
45.00	-6.03
60.00	-8.14
75.00	-11.11
90.00	-14.67
100.00	-17.35
115.00	-22.12
130.00	-26.13
145.00	-30.62
160.00	-35.94
175.00	-41.78
190.00	-47.02
200.00	-52.16

Ni BASE
MAR-M-200

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-008-310-3

1100°C 1.00hr CYCLES 200.00hr TEST 2.297mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE
200 hr
STANDARD SURFACE
NiO
SPINEL, $a_0=8.10\text{\AA}$.
SPINEL, $a_0=8.25\text{\AA}$.
Ni(W,Mo)O₄ TYPE 1
TRI(RUTILE), $d(110)\leq 3.30\text{\AA}$.
NiTiO₃
Al₂O₃
FACE CENTERED CUBIC MATRIX

SPALL
200 hr
COLLECTED SPALL
NiO
Ni(W,Mo)O₄ TYPE 1
SPINEL, $a_0=8.25\text{\AA}$.
TRI(RUTILE), $d(110)\leq 3.30\text{\AA}$.

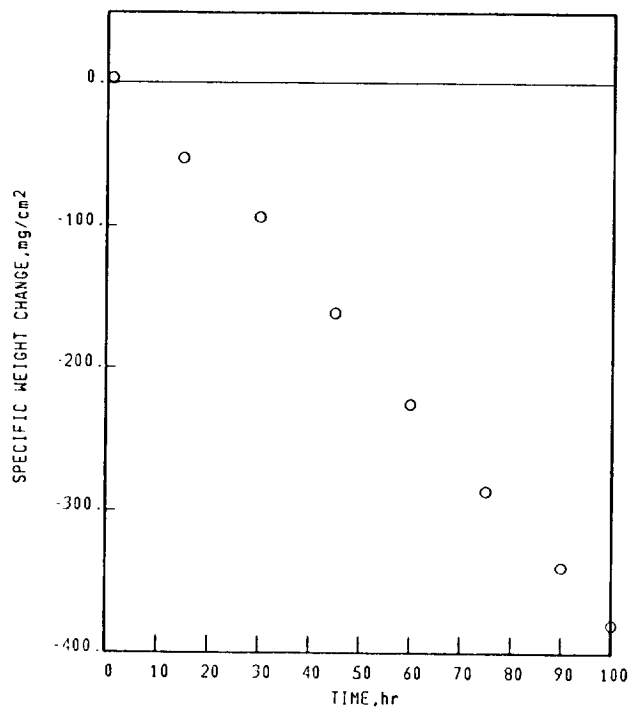
Ni BASE
MAR-M-200+Hf

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-009-225-3

1150°C 1.00hr CYCLES 100.00hr TEST 2.304mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	3.00
15.00	-52.50
30.00	-93.81
45.00	-161.89
60.00	-225.10
75.00	-285.87
90.00	-339.84
100.00	-380.35

Ni BASE
MAR-M-200+Hf

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-009-225-3

1150°C 1.00hr CYCLES 100.00hr TEST 2.304mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

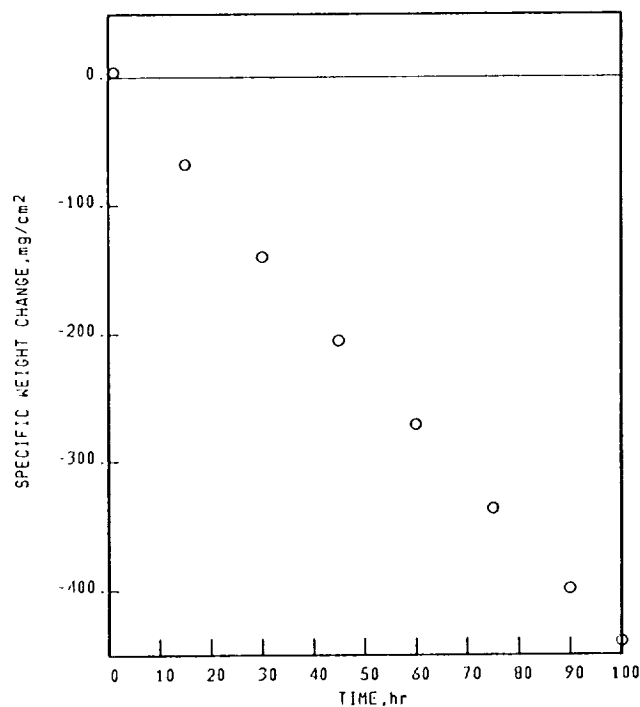
SURFACE
100 hr
STANDARD SURFACE
NiO
Ni(W,Mo)O₄ TYPE 1
SPINEL, a₀=8.10Å.
SPINEL, a₀=8.25Å.
TRI(RUTILE), d(110)≤3.30Å.
HfO₂

FACE CENTERED CUBIC MATRIX

SPALL
100 hr
COLLECTED SPALL
NiO
Ni(W,Mo)O₄ TYPE 1
SPINEL, a₀=8.25Å.
TRI(RUTILE), d(110)≤3.30Å.
HfO₂

Ni BASE COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS 02-04-009-225-6
 MAR-M-200+Hf 1150°C 1.00hr CYCLES 100.00hr TEST 2.304mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	3.95
15.00	-68.25
30.00	-139.76
45.00	-205.30
60.00	-271.22
75.00	-336.73
90.00	-398.75
100.00	-439.85

Ni BASE COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS 02-04-009-225-6
 MAR-M-200+Hf 1150°C 1.00hr CYCLES 100.00hr TEST 2.304mm THICK STATIC AIR

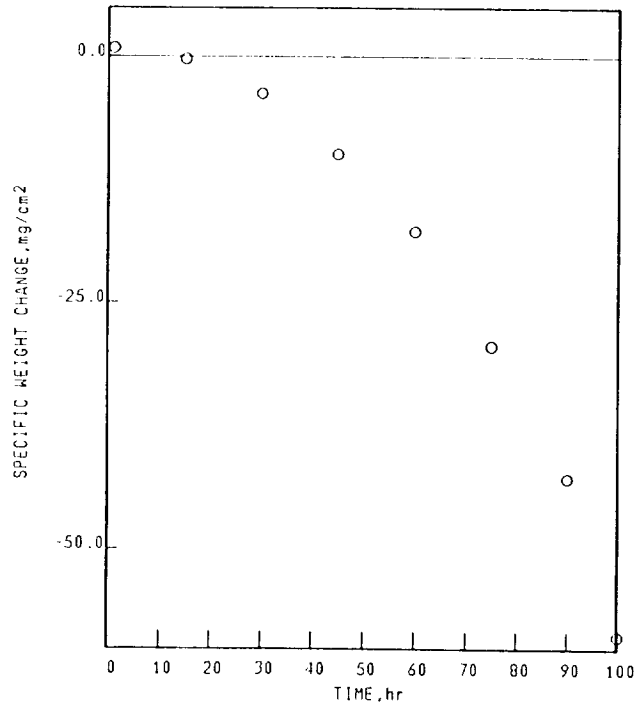
X-RAY DIFFRACTION DATA

SURFACE 100 hr STANDARD SURFACE NiO Ni(W,Mo)O ₄ TYPE 1 SPINEL, a ₀ =8.10Å. SPINEL, a ₀ =8.25Å. TRI(RUTILE), d(110)≤3.30Å. HfO ₂	SPALL 100 hr COLLECTED SPALL NiO Ni(W,Mo)O ₄ TYPE 1 SPINEL, a ₀ =8.25Å. TRI(RUTILE), d(110)≤3.30Å. HfO ₂
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FACE CENTERED CUBIC MATRIX

Ni BASE COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS 02-04-010-225-4
DS-MAR-M-200+Hf 1150°C 1.00hr CYCLES 100.00hr TEST 2.290mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



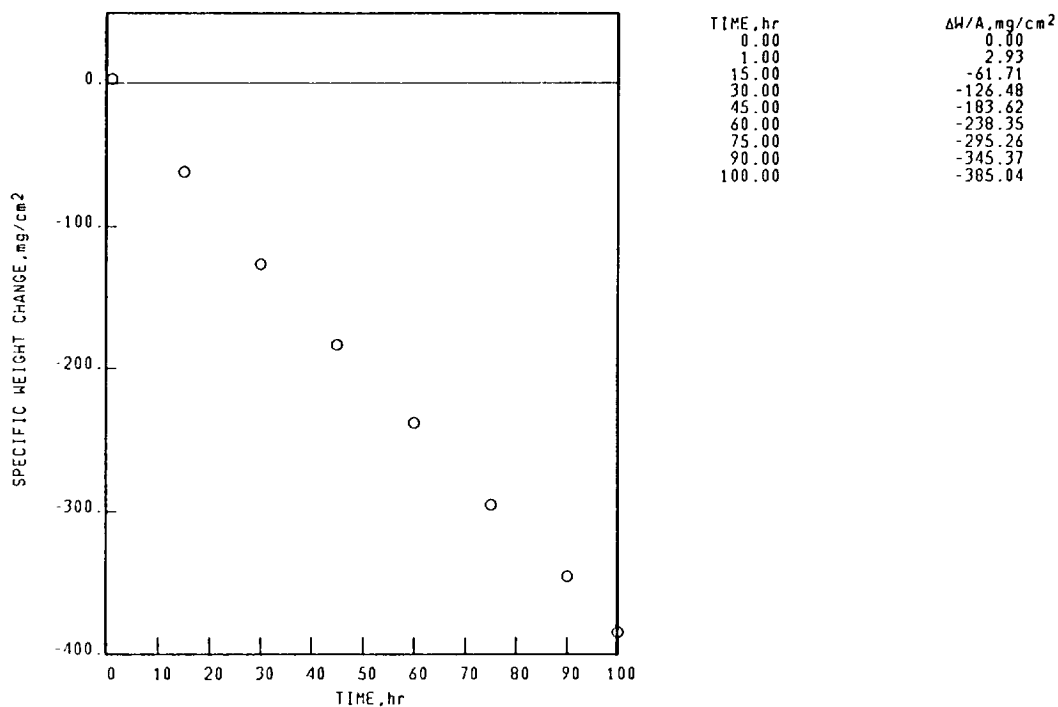
TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.82
15.00	-0.26
30.00	-3.69
45.00	-9.83
60.00	-17.74
75.00	-29.34
90.00	-42.71
100.00	-58.81

Ni BASE COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS 02-04-010-225-4
DS-MAR-M-200+Hf 1150°C 1.00hr CYCLES 100.00hr TEST 2.290mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE	SPALL
100 hr	100 hr
STANDARD SURFACE	COLLECTED SPALL
NiO	NiO
Ni(W,Mo)O ₄ TYPE 1	Ni(W,Mo)O ₄ TYPE 1
SPINEL, a ₀ =8.10Å.	SPINEL, a ₀ =8.25Å.
SPINEL, a ₀ =8.25Å.	TRI(RUTILE), d(110)≤3.30Å.
TRI(RUTILE), d(110)≤3.30Å.	HfO ₂
HfO ₂	
FACE CENTERED CUBIC MATRIX	

Ni BASE COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS 02-04-010-225-5
 DS-MAR-M-200-Hf 1150°C 1.00hr CYCLES 100.00hr TEST 2.297mm THICK STATIC AIR
 SPECIFIC WEIGHT CHANGE DATA



Ni BASE COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS 02-04-010-225-5
 DS-MAR-M-200-Hf 1150°C 1.00hr CYCLES 100.00hr TEST 2.297mm THICK STATIC AIR
 X-RAY DIFFRACTION DATA

SURFACE 100 hr STANDARD SURFACE NiO Ni(W,Mo)O ₄ TYPE 1 SPINEL, $a_0=8.10\text{\AA}$. SPINEL, $a_0=8.25\text{\AA}$. TRI(RUTILE), $d(110)\leq 3.30\text{\AA}$. HfO ₂ FACE CENTERED CUBIC MATRIX	SPALL 100 hr COLLECTED SPALL NiO Ni(W,Mo)O ₄ TYPE 1 SPINEL, $a_0=8.25\text{\AA}$. TRI(RUTILE), $d(110)\leq 3.30\text{\AA}$. HfO ₂
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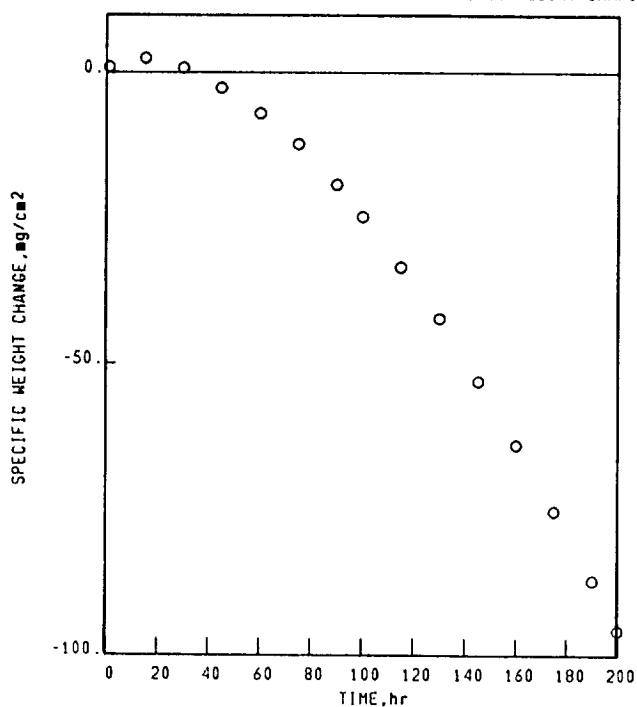
NI BASE
MAR-M-200-Hf

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-009-310-4

1100°C 0.03hr CYCLES 200.00hr TEST 2.300mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.93
15.00	2.46
30.00	0.78
45.00	-2.64
60.00	-7.00
75.00	-12.32
90.00	-19.32
100.00	-24.86
115.00	-33.55
130.00	-42.17
145.00	-53.01
160.00	-64.08
175.00	-75.43
190.00	-87.23
200.00	-95.85

NI BASE
MAR-M-200-Hf

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-009-310-4

1100°C 0.03hr CYCLES 200.00hr TEST 2.300mm THICK STATIC AIR

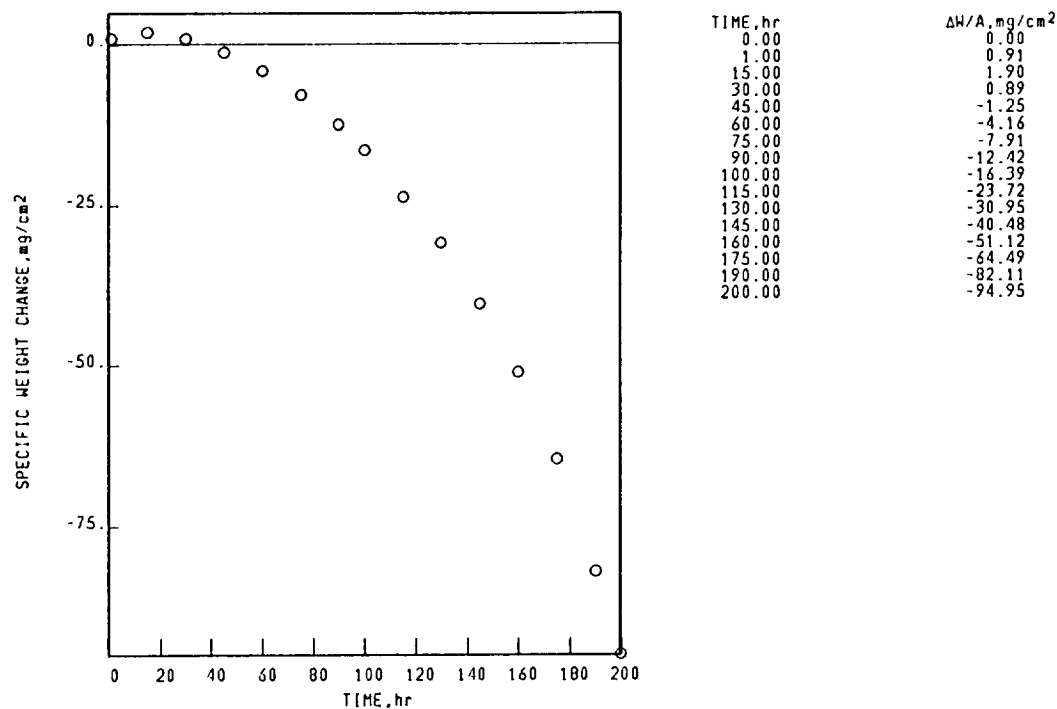
X-RAY DIFFRACTION DATA

SURFACE
200 hr
STANDARD SURFACE
NiO
SPINEL, $a_0=0.25A$.
SPINEL, $a_0=0.10A$.
Ni(W,Mo)O₄ TYPE 1
TRI(RUTILE), $d(110) \leq 3.30A$.
HfO₂

SPALL
200 hr
COLLECTED SPALL
NiO
Ni(W,Mo)O₄ TYPE 1
SPINEL, $a_0=0.25A$.
TRI(RUTILE), $d(110) \leq 3.30A$.
HfO₂

FACE CENTERED CUBIC MATRIX

Ni BASE COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS 02-04-010-310-5
 DS-MAR-M-200-Hf 1100°C 1.00hr CYCLES 200.00hr TEST 2.324mm THICK STATIC AIR
 SPECIFIC WEIGHT CHANGE DATA



Ni BASE COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS 02-04-010-310-5
 DS-MAR-M-200-Hf 1100°C 1.00hr CYCLES 200.00hr TEST 2.324mm THICK STATIC AIR
 X-RAY DIFFRACTION DATA

SURFACE 200 hr STANDARD SURFACE NiO Ni(W,Mo)O ₄ TYPE 1 SPINEL, $a_0=8.10\text{\AA}$. SPINEL, $a_0=8.25\text{\AA}$. TRI(RUTILE), $d(110)\leq 3.30\text{\AA}$. HfO ₂ FACE CENTERED CUBIC MATRIX	SPALL 200 hr COLLECTED SPALL NiO Ni(W,Mo)O ₄ TYPE 1 SPINEL, $a_0=8.25\text{\AA}$. TRI(RUTILE), $d(110)\leq 3.30\text{\AA}$. HfO ₂
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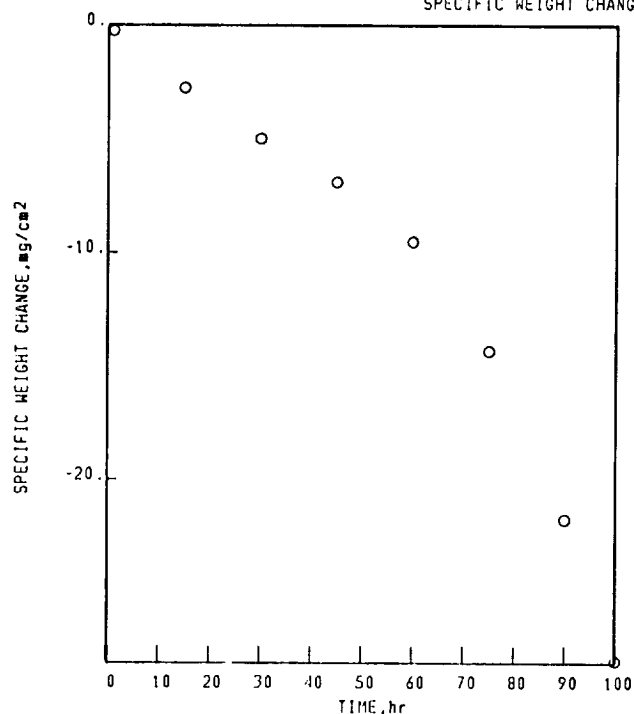
Ni BASE
MAR-M-211

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-011-321-4

1150°C 1.00hr CYCLES 100.00hr TEST 2.248mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	-0.26
15.00	-2.79
30.00	-5.04
45.00	-6.95
60.00	-9.54
75.00	-14.33
90.00	-21.73
100.00	-27.93

Ni BASE
MAR-M-211

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-011-321-4

1150°C 1.00hr CYCLES 100.00hr TEST 2.248mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE
100 hr
STANDARD SURFACE
SPINEL, $a_0 = 8.10\text{\AA}$.
TRI(RUTILE), $d(110) \leq 3.30\text{\AA}$.
 Al_2O_3
FACE CENTERED CUBIC MATRIX

SPALL
100 hr
COLLECTED SPALL
NiO
 Ni(W,Mo)O_4 TYPE 1
SPINEL, $a_0 = 8.25\text{\AA}$.
TRI(RUTILE), $d(110) > 3.30\text{\AA}$.
UNKNOWN LINES, d VALUES
2.76\text{\AA}.

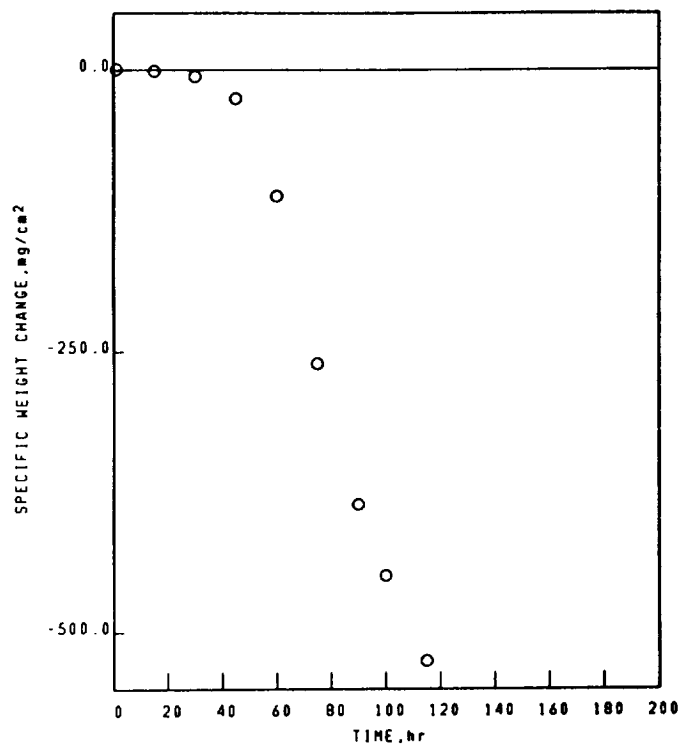
NI BASE
MAR-M-211

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-011-324-4

1100°C 1.00hr CYCLES 115.00hr TEST 2.268mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.69
15.00	-0.77
30.00	-5.54
45.00	-24.83
60.00	-111.77
75.00	-260.46
90.00	-386.49
100.00	-449.99
115.00	-524.89

NI BASE
MAR-M-211

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-011-324-4

1100°C 1.00hr CYCLES 115.00hr TEST 2.268mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE
200 hr
STANDARD SURFACE
Ni(W,Mo)O₄ TYPE 1
SPINEL, $a_0=0.05A$.
SPINEL, $a_0=0.25A$.
TRI(RUTILE), $d(110) \leq 3.30A$.
NiO
FACE CENTERED CUBIC MATRIX

SPALL
200 hr
COLLECTED SPALL
NiO
Ni(W,Mo)O₄ TYPE 1
SPINEL, $a_0=0.25A$.
SPINEL, $a_0=0.10A$.
Ni(W,Mo)O₄ TYPE 2
TRI(RUTILE), $d(110) > 3.30A$.

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-012-322-3

MAR-M-246

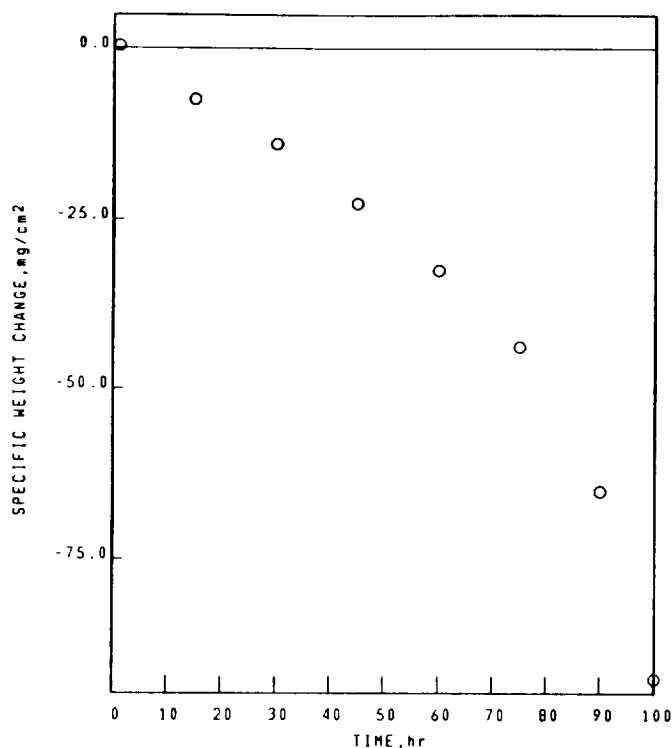
1150°C

1.00hr CYCLES

100.00hr TEST 2.238mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr

ΔW/A, mg/cm²

0.00

0.00

1.00

0.38

15.00

-7.55

30.00

-14.10

45.00

-22.73

60.00

-32.57

75.00

-43.87

90.00

-65.03

100.00

-92.89

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-012-322-3

MAR-M-246

1150°C

1.00hr CYCLES

100.00hr TEST 2.238mm THICK

STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

100 hr

STANDARD SURFACE

NiO

SPINEL, $a_0=8.25\text{\AA}$.

TRI(RUTILE), $d(110)\leq 3.30\text{\AA}$.

SPINEL, $a_0=8.10\text{\AA}$.

Al₂O₃

Cr₂O₃

FACE CENTERED CUBIC MATRIX

SPALL

100 hr

COLLECTED SPALL

NiO

SPINEL, $a_0=8.25\text{\AA}$.

SPINEL, $a_0=8.05\text{\AA}$.

TRI(RUTILE), $d(110)\leq 3.30\text{\AA}$.

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-012-325-3

MAR-M-246

1100°C

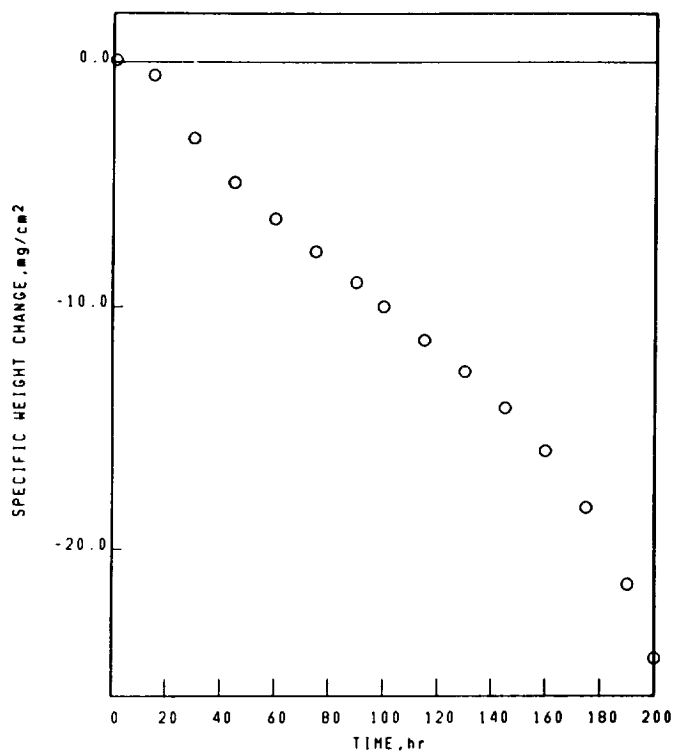
1.00hr CYCLES

200.00hr TEST

2.249mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.09
15.00	-0.53
30.00	-3.12
45.00	-4.95
60.00	-6.44
75.00	-7.80
90.00	-9.05
100.00	-10.02
115.00	-11.39
130.00	-12.67
145.00	-14.18
160.00	-15.97
175.00	-18.29
190.00	-21.42
200.00	-24.44

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-012-325-3

MAR-M-246

1100°C

1.00hr CYCLES

200.00hr TEST

2.249mm THICK

STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

200 hr

STANDARD SURFACE

SPINEL, $a_0 = 8.10 \text{ \AA}$.

NiO

SPINEL, $a_0 = 8.25 \text{ \AA}$.

TRI(RUTILE), $d(110) \leq 3.30 \text{ \AA}$.

Cr₂O₃

FACE CENTERED CUBIC MATRIX

SPALL

200 hr

COLLECTED SPALL

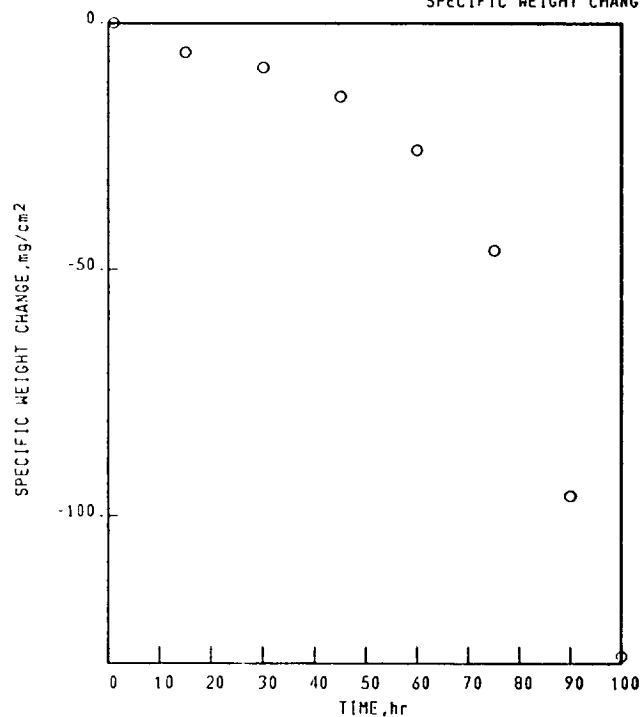
NiO

SPINEL, $a_0 = 8.30 \text{ \AA}$.

TRI(RUTILE), $d(110) \leq 3.30 \text{ \AA}$.

Ni BASE COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS 02-04-013-322-1
 MAR-M-421 1150°C 1.00hr CYCLES 100.00hr TEST 2.181mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔH/A, mg/cm²
0.00	0.00
1.00	-0.06
15.00	-6.03
30.00	-9.05
45.00	-14.93
60.00	-25.64
75.00	-46.09
90.00	-95.81
100.00	-128.66

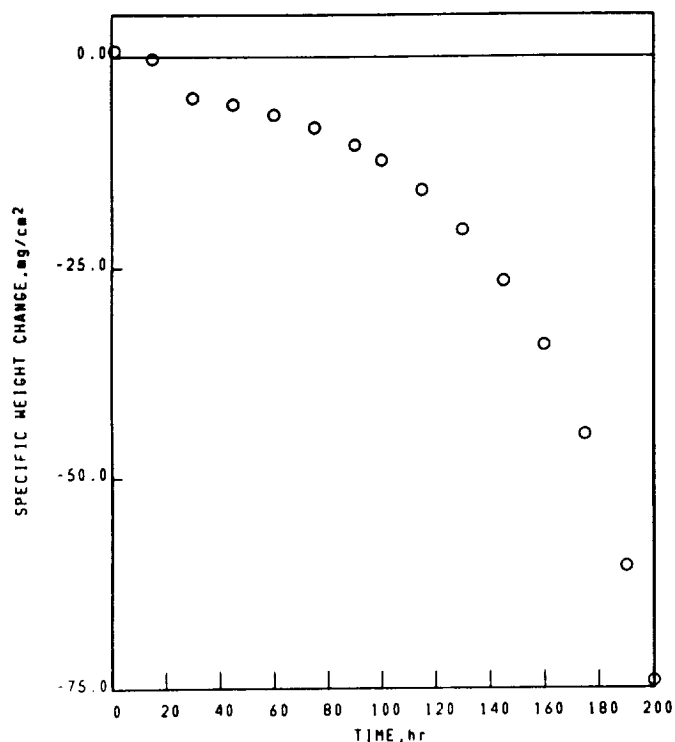
Ni BASE COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS 02-04-013-322-1
 MAR-M-421 1150°C 1.00hr CYCLES 100.00hr TEST 2.181mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE	SPALL
100 hr	100 hr
STANDARD SURFACE	COLLECTED SPALL
NiO	NiO
SPINEL, $a_0=8.30\text{\AA}$.	SPINEL, $a_0=8.30\text{\AA}$.
Cr ₂ O ₃	Ni(W,Mo)O ₄ TYPE 1
TRI(RUTILE), $d(110)\leq 3.30\text{\AA}$.	TRI(RUTILE), $d(110)\leq 3.30\text{\AA}$.
	Cr ₂ O ₃
FACE CENTERED CUBIC MATRIX	UNKNOWN LINES, d VALUES
	2.76 \AA .

Ni BASE COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS 02-04-013-325-1
 MAR-M-421 1100°C 1.00hr CYCLES 200.00hr TEST 2.183mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.68
15.00	-0.27
30.00	-4.90
45.00	-5.70
60.00	-6.90
75.00	-8.46
90.00	-10.54
100.00	-12.35
115.00	-15.85
130.00	-20.49
145.00	-26.58
160.00	-34.25
175.00	-44.94
190.00	-60.43
200.00	-74.11

Ni BASE COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS 02-04-013-325-1
 MAR-M-421 1100°C 1.00hr CYCLES 200.00hr TEST 2.183mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE 200 hr STANDARD SURFACE NiO SPINEL, $a_0 = 8.30\text{\AA}$. Cr ₂ O ₃ TR1(RUTILE), $d(110) \leq 3.30\text{\AA}$. Ni(W,Mo)O ₄ TYPE 1 FACE CENTERED CUBIC MATRIX	SPALL 200 hr COLLECTED SPALL NiO SPINEL, $a_0 = 8.25\text{\AA}$. Ni(W,Mo)O ₄ TYPE 1 TR1(RUTILE), $d(110) \leq 3.30\text{\AA}$. Cr ₂ O ₃ UNKNOWN LINES, d VALUES 2.72Å.
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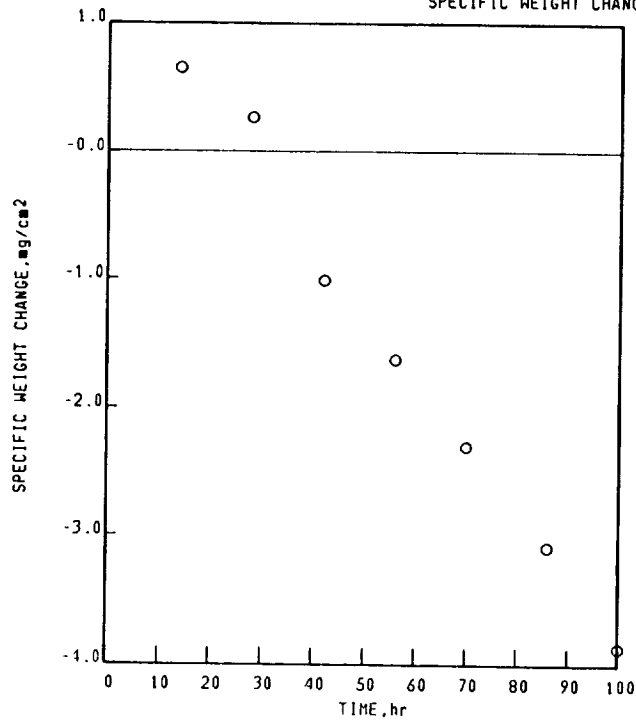
Ni BASE
NASA-TRW-VI-A

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-021-041-3

1150°C 1.00hr CYCLES 100.00hr TEST 6.500mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
14.00	0.65
28.00	0.26
42.00	-1.01
56.00	-1.62
70.00	-2.30
86.00	-3.09
100.00	-3.87

Ni BASE
NASA-TRW-VI-A

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-021-041-3

1150°C 1.00hr CYCLES 100.00hr TEST 6.500mm THICK STATIC AIR

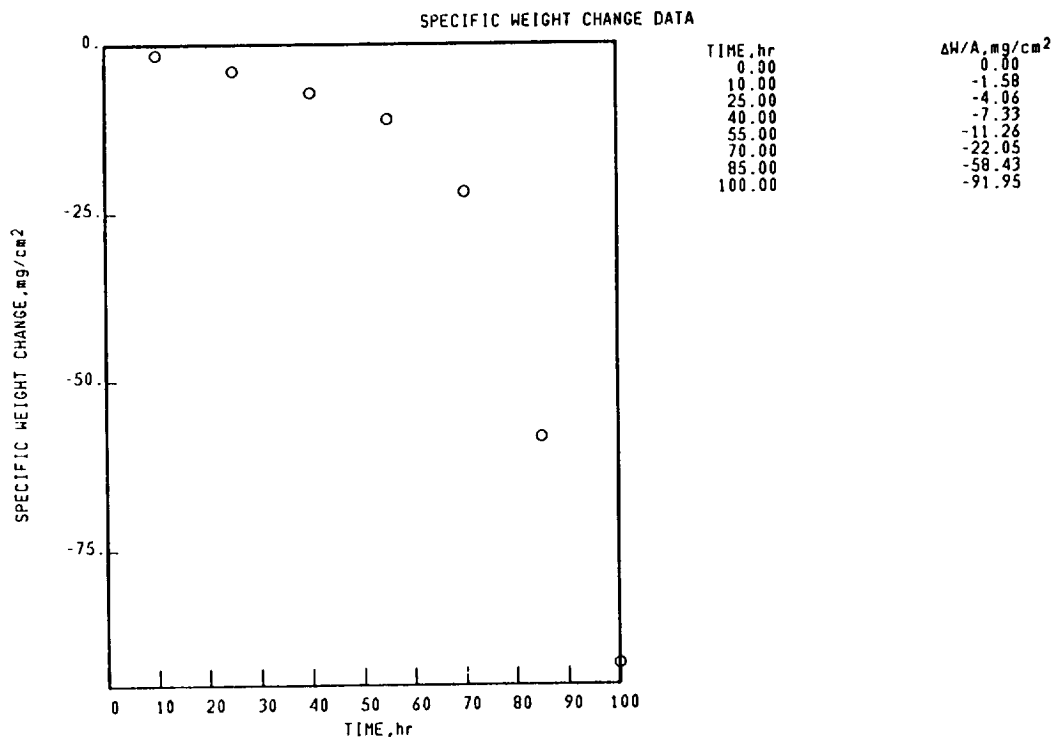
X-RAY DIFFRACTION DATA

SURFACE
100 hr
STANDARD SURFACE
TRI(RUTILE), d(110) ≤ 3.30 Å.
SPINEL, $a_0 = 8.15 \text{ Å}$.
Al₂O₃

SPALL
100 hr
COLLECTED SPALL
NiO
TRI(RUTILE), d(110) ≤ 3.30 Å.
SPINEL, $a_0 = 8.15 \text{ Å}$.

FACE CENTERED CUBIC MATRIX

Ni BASE COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS 02-04-021-078-3
 NASA-TRW-VI-A 1150°C 1.00hr CYCLES 100.00hr TEST 6.400mm THICK STATIC AIR

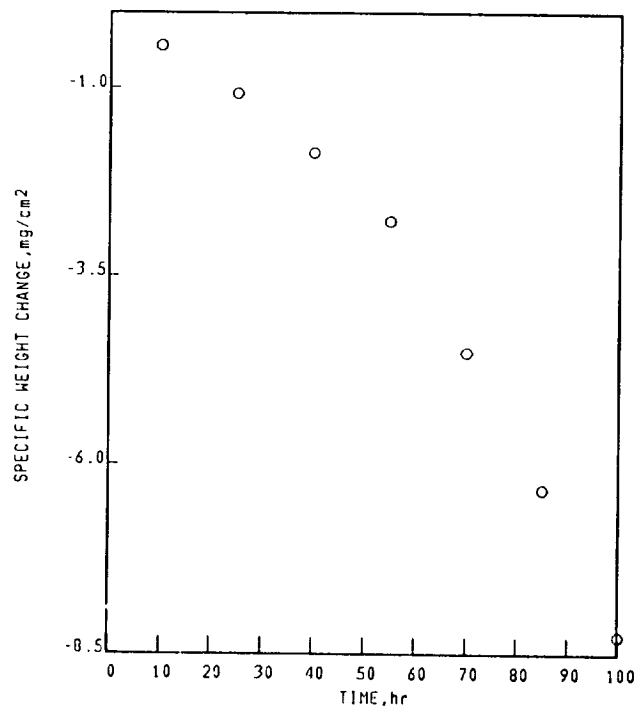


Ni BASE COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS 02-04-021-078-3
 NASA-TRW-VI-A 1150°C 1.00hr CYCLES 100.00hr TEST 6.400mm THICK STATIC AIR
 X-RAY DIFFRACTION DATA

SURFACE 100 hr STANDARD SURFACE TRI(RUTILE), $d(110) \leq 3.30\text{\AA}$. NiO SPINEL, $a_0 = 0.10\text{\AA}$. ZrO ₂ FACE CENTERED CUBIC MATRIX	SPALL 100 hr COLLECTED SPALL TRI(RUTILE), $d(110) \leq 3.30\text{\AA}$. Al ₂ O ₃ TRI(RUTILE), $d(110) \leq 3.30\text{\AA}$. UNKNOWN LINES, d VALUES 3.13\AA. 2.87\AA. 0.90\AA.
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Ni BASE
 NASA-TRW-VI-A
 COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS
 1150°C 1.00hr CYCLES 100.00hr TEST 6.530mm THICK STATIC AIR
 02-04-021-078-6

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
10.00	-0.44
25.00	-1.08
40.00	-1.87
55.00	-2.78
70.00	-4.50
85.00	-6.33
100.00	-8.27

Ni BASE
 NASA-TRW-VI-A
 COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS
 1150°C 1.00hr CYCLES 100.00hr TEST 6.530mm THICK STATIC AIR
 02-04-021-078-6

X-RAY DIFFRACTION DATA

SURFACE
 100 hr
 STANDARD SURFACE
 TRI(RUTILE), d(110) ≤ 3.30A.
 SPINEL, a₀ = 8.10A.
 Al₂O₃
 ZrO₂
 NiO

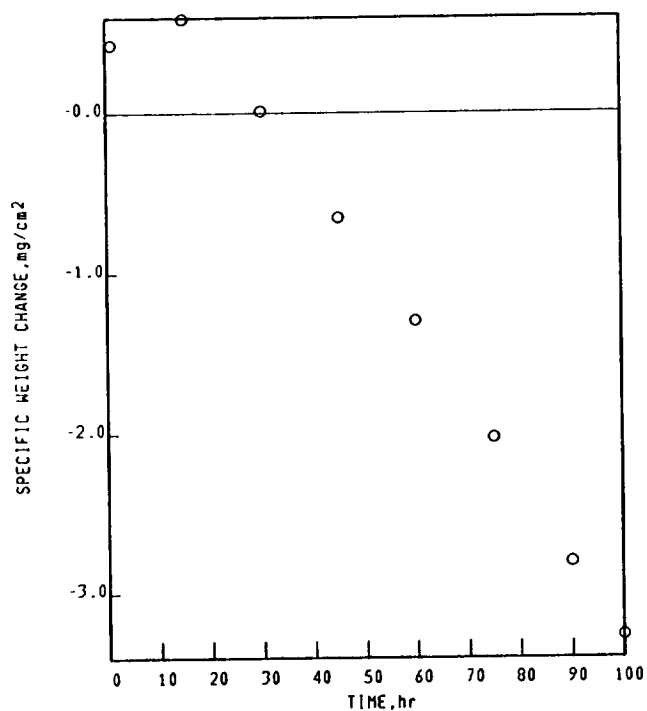
SPALL
 100 hr
 COLLECTED SPALL
 NiO
 TRI(RUTILE), d(110) ≤ 3.30A.
 TRI(RUTILE), d(110) > 3.30A.
 TRI(RUTILE), d(110) ≤ 3.30A.
 SPINEL, a₀ = 8.05A.

FACE CENTERED CUBIC MATRIX

UNKNOWN LINES, d VALUES
 2.91A.

Ni BASE COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS 02-04-021-101-4
 NASA-TRW-VI-A 1150°C 1.00hr CYCLES 100.00hr TEST 2.787mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.43
15.00	0.59
30.00	0.01
45.00	-0.65
60.00	-1.30
75.00	-2.03
90.00	-2.80
100.00	-3.26

Ni BASE COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS 02-04-021-101-4
 NASA-TRW-VI-A 1150°C 1.00hr CYCLES 100.00hr TEST 2.787mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE
 100 hr
 STANDARD SURFACE
 Al_2O_3
 $TRT(RUTILE), d(110) \leq 3.30A.$
 $SPINEL, a_0 = 8.15A.$
 FACE CENTERED CUBIC MATRIX

SPALL
 100 hr
 COLLECTED SPALL
 $TRT(RUTILE), d(110) > 3.30A.$
 $TRT(RUTILE), d(110) \leq 3.30A.$
 NiO
 $SPINEL, a_0 = 8.05A.$

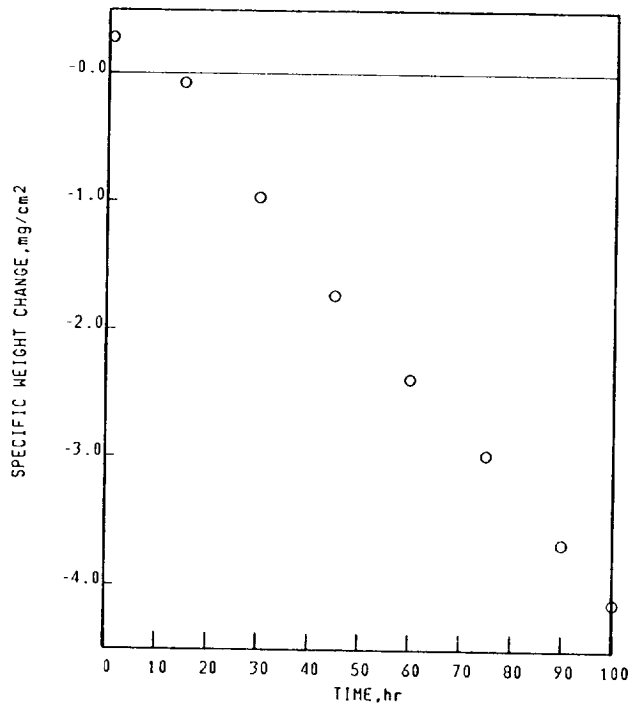
Ni BASE
NASA-TRW-VI-A

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-021-101-5

1150°C 1.00hr CYCLES 100.00hr TEST 2.690mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.28
15.00	-0.08
30.00	-0.97
45.00	-1.73
60.00	-2.39
75.00	-2.98
90.00	-3.66
100.00	-4.13

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-021-129-1

NASA-TRW-VI-A

1150°C

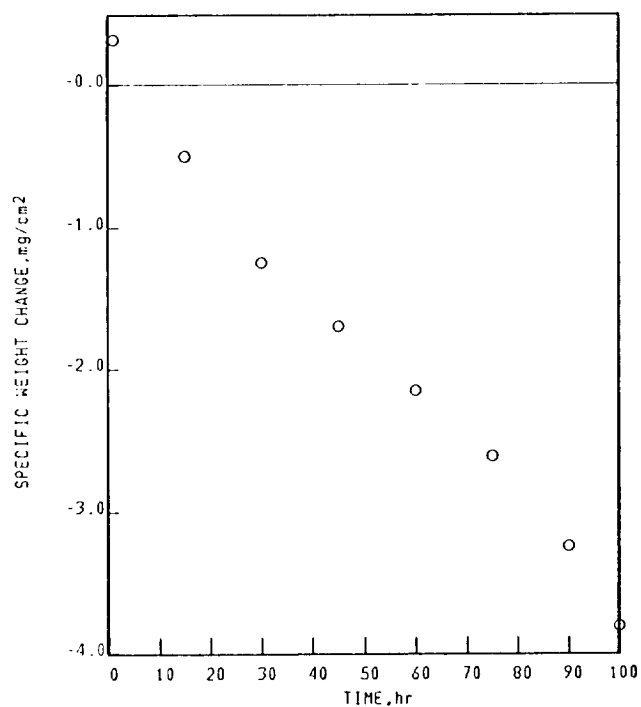
1.00hr CYCLES

100.00hr TEST

1.150mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	$\Delta W/A, \text{mg/cm}^2$
0.00	0.00
1.00	0.32
15.00	-0.50
30.00	-1.25
45.00	-1.70
60.00	-2.15
75.00	-2.61
90.00	-3.24
100.00	-3.81

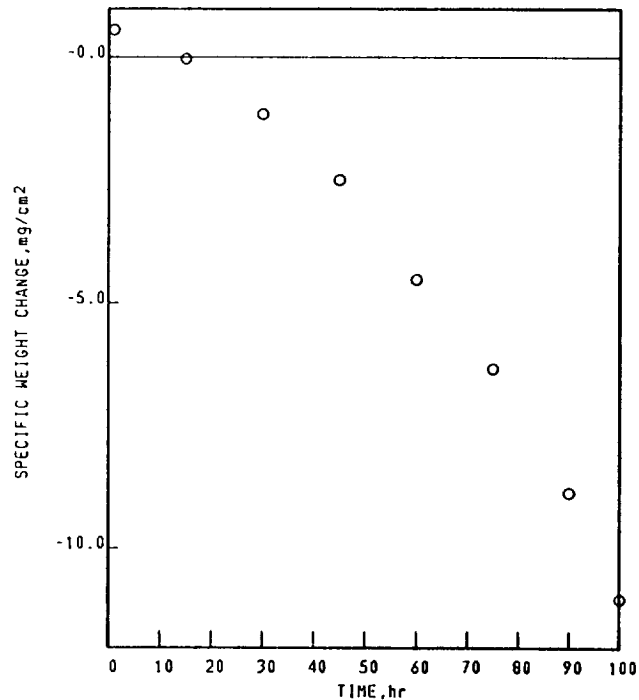
Ni BASE
NASA-TRW-VI-A

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-021-129-3

1150°C 1.00hr CYCLES 100.00hr TEST 2.291mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME,hr	ΔW/A,mg/cm²
0.00	0.00
1.00	0.56
15.00	-0.04
30.00	-1.17
45.00	-2.52
60.00	-4.52
75.00	-6.33
90.00	-8.87
100.00	-11.01

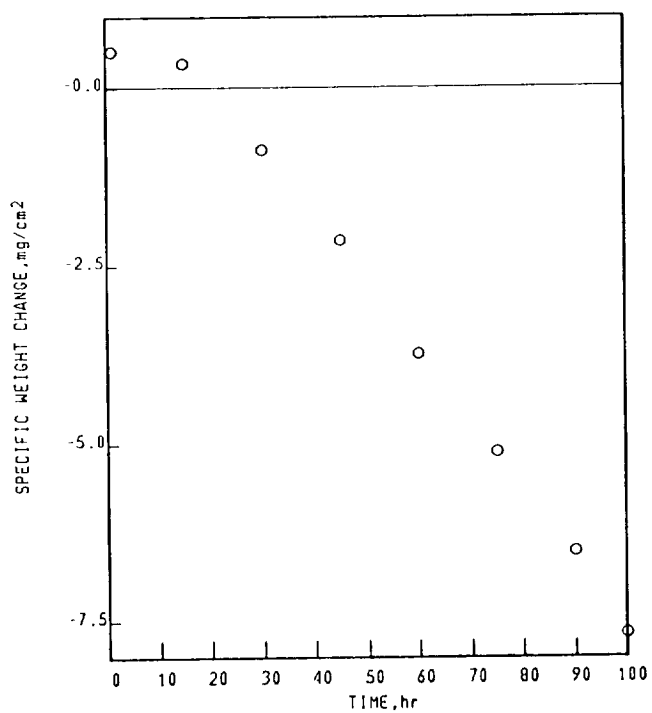
Ni BASE
NASA-TRW-VI-A

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-021-129-4

1150°C 1.00hr CYCLES 100.00hr TEST 2.293mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.51
15.00	0.34
30.00	-0.86
45.00	-2.13
60.00	-3.75
75.00	-5.11
90.00	-6.52
100.00	-7.68

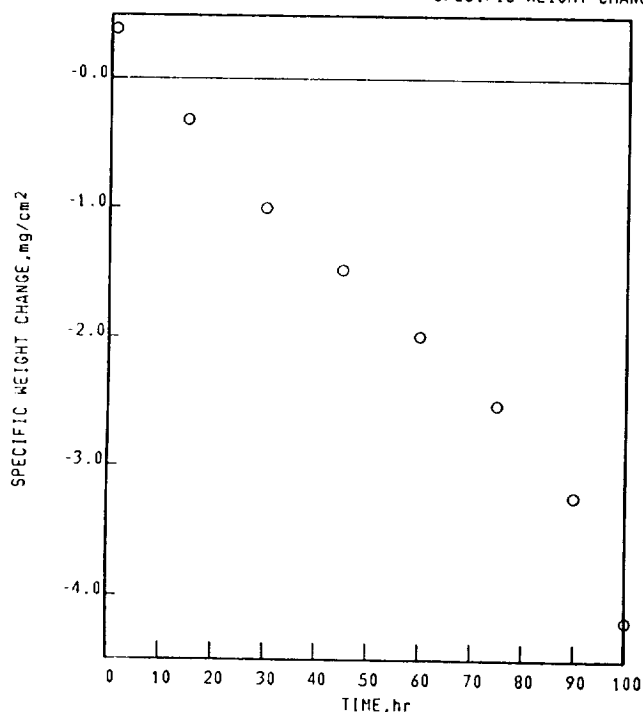
NI BASE
NASA-TRW-VI-A

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-021-129-5

1150°C 1.00hr CYCLES 100.00hr TEST 1.149mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.39
15.00	-0.32
30.00	-1.01
45.00	-1.48
60.00	-1.99
75.00	-2.53
90.00	-3.23
100.00	-4.20

NI BASE
NASA-TRW-VI-A

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-021-129-5

1150°C 1.00hr CYCLES 100.00hr TEST 1.149mm THICK STATIC AIR

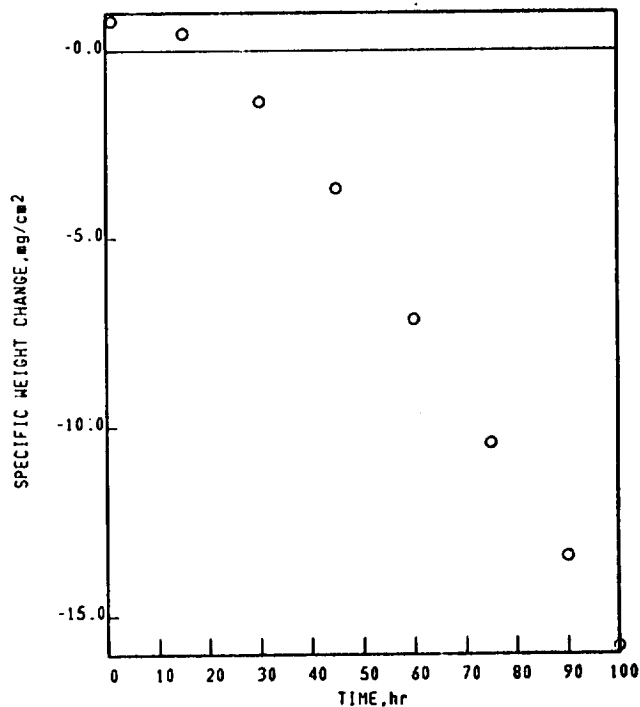
X-RAY DIFFRACTION DATA

SURFACE
100 hr
STANDARD SURFACE
SPINEL, $a_0=8.10\text{\AA}$.
TRI(RUTILE), $d(110)\leq 3.30\text{\AA}$.
 Al_2O_3
 ZrO_2
FACE CENTERED CUBIC MATRIX

SPALL
100 hr
COLLECTED SPALL
 NiO
TRI(RUTILE), $d(110)\leq 3.30\text{\AA}$.
 Ni(W,Mo)O_4 TYPE 1
SPINEL, $a_0=8.10\text{\AA}$.
TRI(RUTILE), $d(110)\leq 3.30\text{\AA}$.
 Al_2O_3

1150°C 1.00hr CYCLES 100.00hr TEST 2.292mm THICK STATIC AIR

SPECIFIC HEIGHT CHANGE DATA



TIME, hr	$\Delta H/A, \text{mg/cm}^2$
0.00	0.00
1.00	0.76
15.00	0.45
30.00	-1.36
45.00	-3.68
60.00	-7.16
75.00	-10.44
90.00	-13.45
100.00	-15.81

NI BASE
NASA-TRW-VI-A

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-021-129-6

1150°C 1.00hr CYCLES 100.00hr TEST 2.292mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE
100 hr
STANDARD SURFACE
SPINEL, $a_0 = 8.10 \text{ \AA}$.
TRI(RUTILE), $d(110) \leq 3.30 \text{ \AA}$.
 Al_2O_3
 ZrO_2

FACE CENTERED CUBIC MATRIX

SPALL
100 hr
COLLECTED SPALL
NiO
TRI(RUTILE), $d(110) \leq 3.30 \text{ \AA}$.
Ni(W,Mo)O₄ TYPE 1
SPINEL, $a_0 = 8.10 \text{ \AA}$.

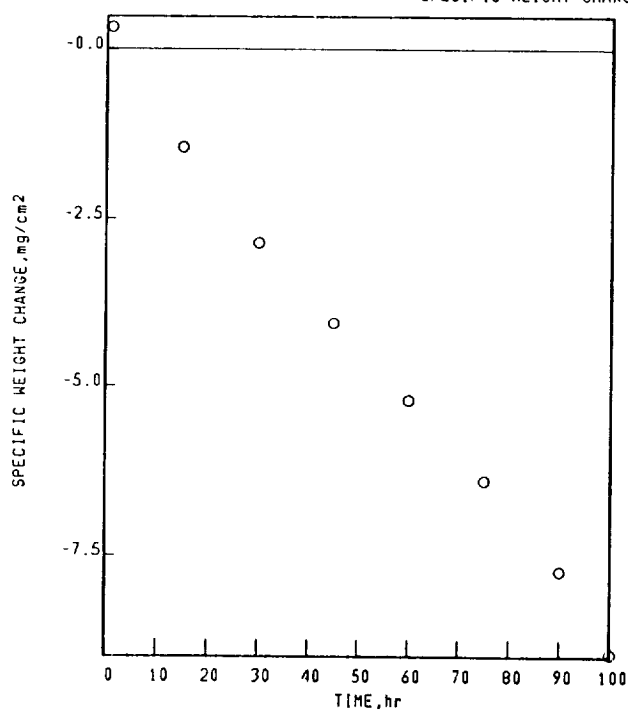
NI BASE
NASA-TRW-VI-A

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-021-204-5

1150°C 1.00hr CYCLES 100.00hr TEST 2.754mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.33
15.00	-1.45
30.00	-2.86
45.00	-4.06
60.00	-5.20
75.00	-6.38
90.00	-7.72
100.00	-8.96

NI BASE
NASA-TRW-VI-A

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-021-204-5

1150°C 1.00hr CYCLES 100.00hr TEST 2.754mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

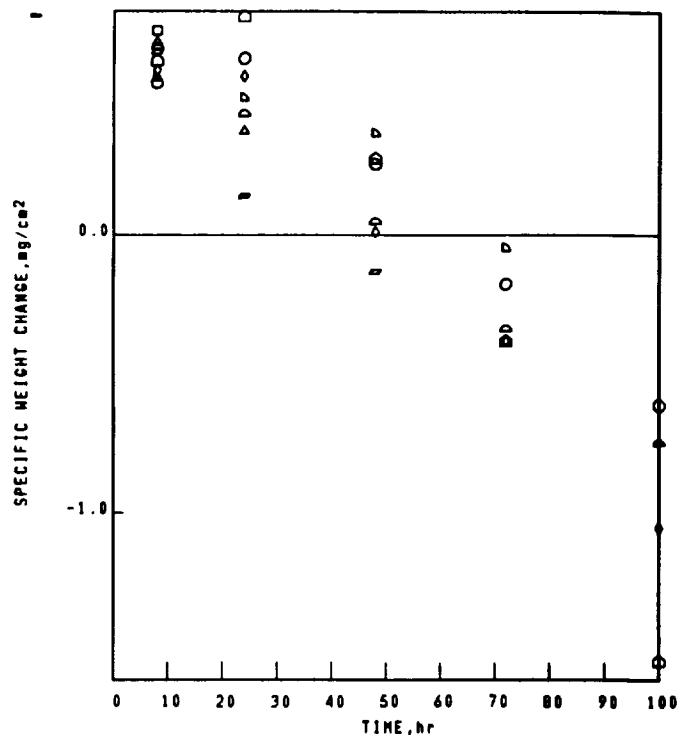
SURFACE
100 hr
STANDARD SURFACE
Cr₂O₃
Al₂O₃

FACE CENTERED CUBIC MATRIX

SPALL
100 hr
COLLECTED SPALL
NiO
TRI(RUTILE), d(110) > 3.30Å.
TRI(RUTILE), d(110) ≤ 3.30Å.

UNKNOWN LINES, d VALUES
1.43Å.
1.38Å.
1.06Å.

SPECIFIC WEIGHT CHANGE DATA



○ 02-04-021-001-4
 □ 02-04-021-001-1
 △ 02-04-021-001-2
 ◇ 02-04-021-001-3
 ● 02-04-021-001-4
 ⊕ 02-04-021-001-5
 ⊕ 02-04-021-010-4
 ⊕ 02-04-021-010-5

TIME, hr	ΔH/A, mg/cm²
0.00	0.00
8.00	0.54
24.00	0.63
48.00	0.25
72.00	-0.18
100.00	-0.61
TIME, hr	ΔH/A, mg/cm² 001-1
0.00	0.00
8.00	0.73
TIME, hr	ΔH/A, mg/cm² 001-2
0.00	0.00
8.00	0.49
24.00	0.37
TIME, hr	ΔH/A, mg/cm² 001-3
0.00	0.00
8.00	0.65
24.00	0.14
48.00	-0.13
TIME, hr	ΔH/A, mg/cm² 001-4
0.00	0.00
8.00	0.56
24.00	0.49
46.00	0.36
72.00	-0.05
TIME, hr	ΔH/A, mg/cm² 001-5
0.00	0.00
8.00	0.67
24.00	0.44
48.00	0.05
72.00	-0.34
100.00	-0.74
TIME, hr	ΔH/A, mg/cm² 010-4
0.00	0.00
8.00	0.59
24.00	0.57
48.00	0.01
72.00	-0.38
100.00	-1.05
TIME, hr	ΔH/A, mg/cm² 010-5
0.00	0.00
8.00	0.62
24.00	0.70
48.00	0.20
72.00	-0.30
100.00	-1.53

X-RAY DIFFRACTION DATA

SURFACE
 8 hr
 STANDARD SURFACE
 TRI(RUTILE), d(110) ≤ 3.30A.
 Al₂O₃
 SPINEL, a₀ = 8.10A.
 SPINEL, a₀ = 8.30A.

FACE CENTERED CUBIC MATRIX

SPALL
 8 hr
 NO SIGNIFICANT SPALL OBSERVED 001-1

SURFACE
 100 hr
 STANDARD SURFACE
 TRI(RUTILE), d(110) ≤ 3.30A.
 SPINEL, a₀ = 8.10A.
 Al₂O₃

FACE CENTERED CUBIC MATRIX

SPALL
 100 hr
 COLLECTED SPALL
 TRI(RUTILE), d(110) ≤ 3.30A.
 Cr₂O₃ 001-5

Ni BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-021-103-1

NASA-TRW-VI-A

1100°C

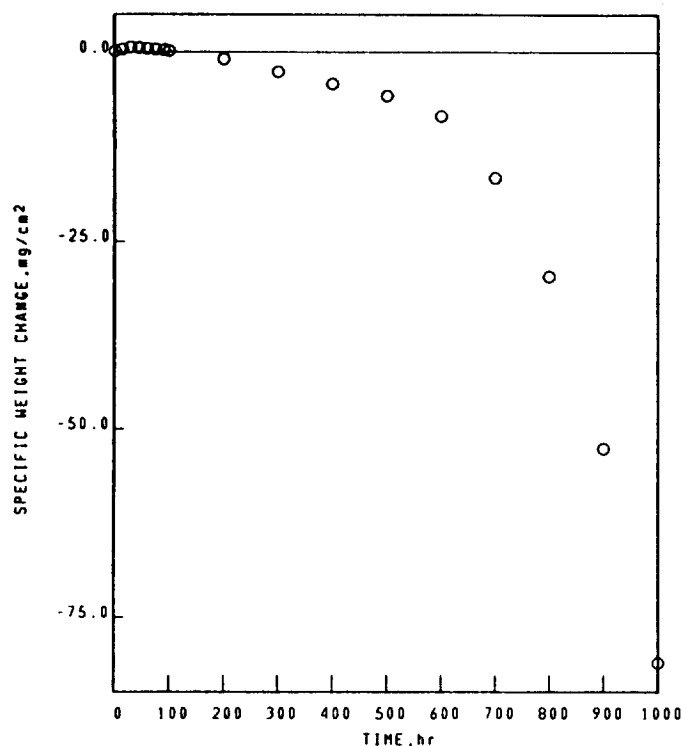
1.00hr CYCLES

1000.00hr TEST

6.240mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.15
15.00	0.40
30.00	0.66
45.00	0.57
60.00	0.47
75.00	0.37
90.00	0.27
100.00	0.18
200.00	-0.94
300.00	-2.56
400.00	-4.18
500.00	-5.83
600.00	-8.53
700.00	-16.76
800.00	-29.72
900.00	-52.64
1000.00	-81.11

Ni BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-021-103-1

NASA-TRW-VI-A

1100°C

1.00hr CYCLES

1000.00hr TEST

6.240mm THICK

STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

500 hr

SURFACE NOT SATISFACTORY-NO XRD

SPALL

500 hr

COLLECTED SPALL

TRI(RUTILE), $d(110) > 3.30\text{\AA}$.TRI(RUTILE), $d(110) \leq 3.30\text{\AA}$.

NiO

SPINEL, $a_0 = 8.20\text{\AA}$.

600 hr

SURFACE NOT SATISFACTORY-NO XRD

600 hr

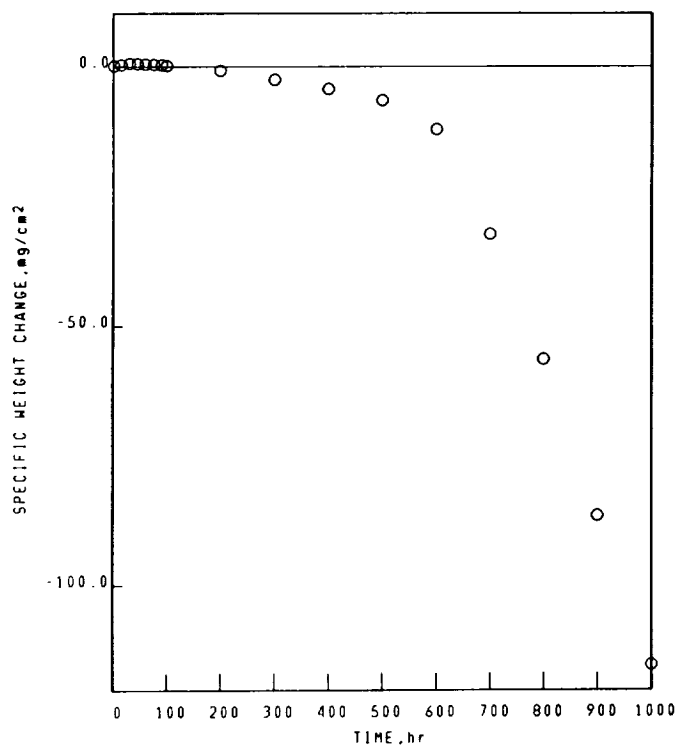
COLLECTED SPALL

NiO

TRI(RUTILE), $d(110) \leq 3.30\text{\AA}$.TRI(RUTILE), $d(110) \leq 3.30\text{\AA}$.SPINEL, $a_0 = 8.15\text{\AA}$.

Ni BASE COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS 02-04-021-103-2
 NASA-TRW-VI-A 1100°C 1.00hr CYCLES 1000.00hr TEST 6.240mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.12
15.00	0.34
30.00	0.61
45.00	0.53
60.00	0.45
75.00	0.40
90.00	0.31
100.00	0.19
200.00	-0.77
300.00	-2.49
400.00	-4.32
500.00	-6.51
600.00	-12.13
700.00	-32.45
800.00	-56.37
900.00	-86.57
1000.00	-115.12

Ni BASE COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS 02-04-021-103-2
 NASA-TRW-VI-A 1100°C 1.00hr CYCLES 1000.00hr TEST 6.240mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE 500 hr SURFACE NOT SATISFACTORY-NO XRD	SPALL 500 hr COLLECTED SPALL NiO SPINEL, $a_g = 8.25\text{\AA}$. TRI(RUTILE), $d(110) > 3.30\text{\AA}$.
600 hr SURFACE NOT SATISFACTORY-NO XRD	600 hr COLLECTED SPALL NiO TRI(RUTILE), $d(110) > 3.30\text{\AA}$. SPINEL, $a_g = 8.15\text{\AA}$.

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-021-103-6

NASA-TRW-VI-A

1100°C

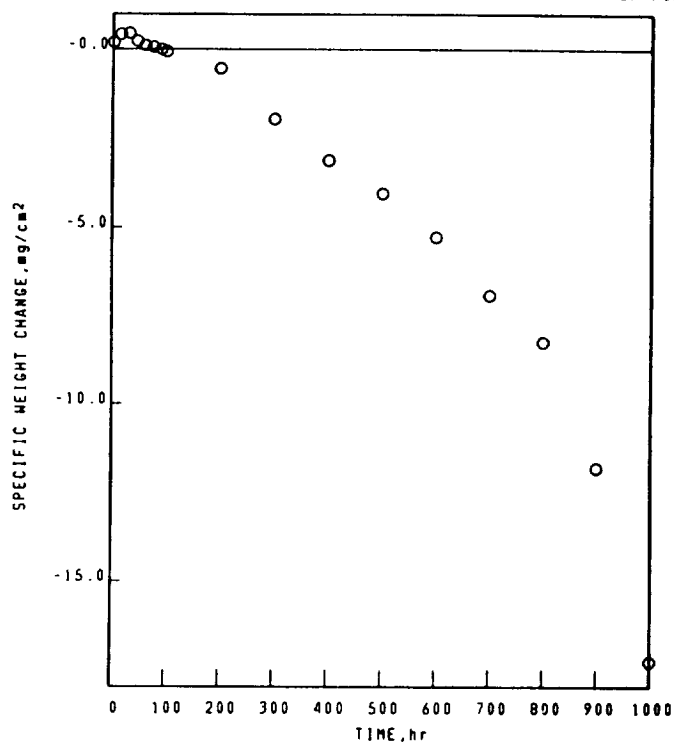
1.00hr CYCLES

1000.00hr TEST

6.240mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.19
15.00	0.43
30.00	0.46
45.00	0.23
60.00	0.11
75.00	0.06
90.00	-0.01
100.00	-0.06
200.00	-0.54
300.00	-1.96
400.00	-3.12
500.00	-4.03
600.00	-5.26
700.00	-6.91
800.00	-8.25
900.00	-11.78
1000.00	-17.29

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-021-103-6

NASA-TRW-VI-A

1100°C

1.00hr CYCLES

1000.00hr TEST

6.240mm THICK

STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

500 hr

SURFACE NOT SATISFACTORY-NO XRD

SPALL

500 hr

COLLECTED SPALL

TRI(RUTILE), d(110) ≤ 3.30Å.

NiO

TRI(RUTILE), d(110) ≤ 3.30Å.

SPINEL, $a_0 = 8.25\text{Å}$.

Al₂O₃

600 hr

SURFACE NOT SATISFACTORY-NO XRD

600 hr

COLLECTED SPALL

NiO

TRI(RUTILE), d(110) > 3.30Å.

TRI(RUTILE), d(110) ≤ 3.30Å.

SPINEL, $a_0 = 8.25\text{Å}$.

UNKNOWN LINES, d VALUES

1.72Å.

1.26Å.

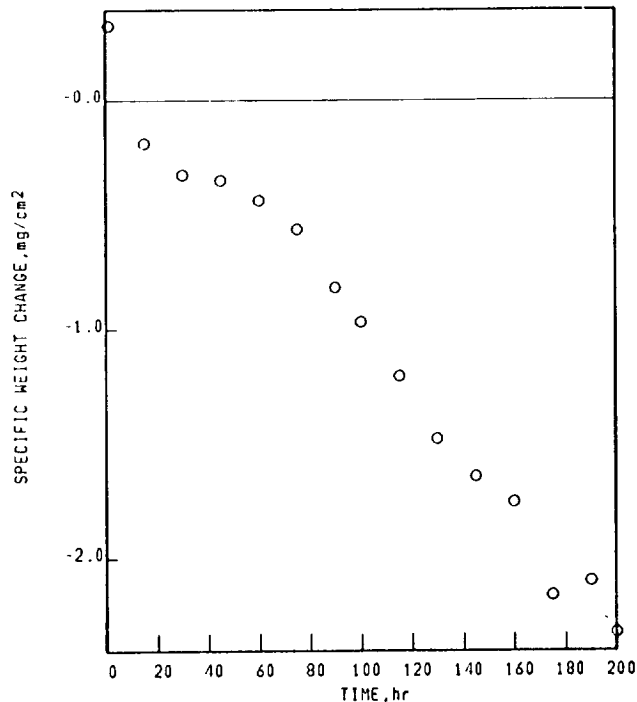
Ni BASE
NASA-TRW-VI-A

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-021-190-6

1100°C 1.00hr CYCLES 200.00hr TEST 2.737mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.33
15.00	-0.19
30.00	-0.33
45.00	-0.35
60.00	-0.44
75.00	-0.57
90.00	-0.82
100.00	-0.97
115.00	-1.21
130.00	-1.48
145.00	-1.64
160.00	-1.76
175.00	-2.16
190.00	-2.10
200.00	-2.32

Ni BASE
NASA-TRW-VI-A

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-021-190-6

1100°C 1.00hr CYCLES 200.00hr TEST 2.737mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE
200 hr
STANDARD SURFACE
SPINEL, $a_0=8.10\text{\AA}$.
 Al_2O_3
 $\text{TR}(\text{RUTILE}), d(110) \leq 3.30\text{\AA}$.
FACE CENTERED CUBIC MATRIX

SPALL
200 hr
COLLECTED SPALL
SPINEL, $a_0=8.05\text{\AA}$.

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-021-005-6

NASA-TRN-VI-A

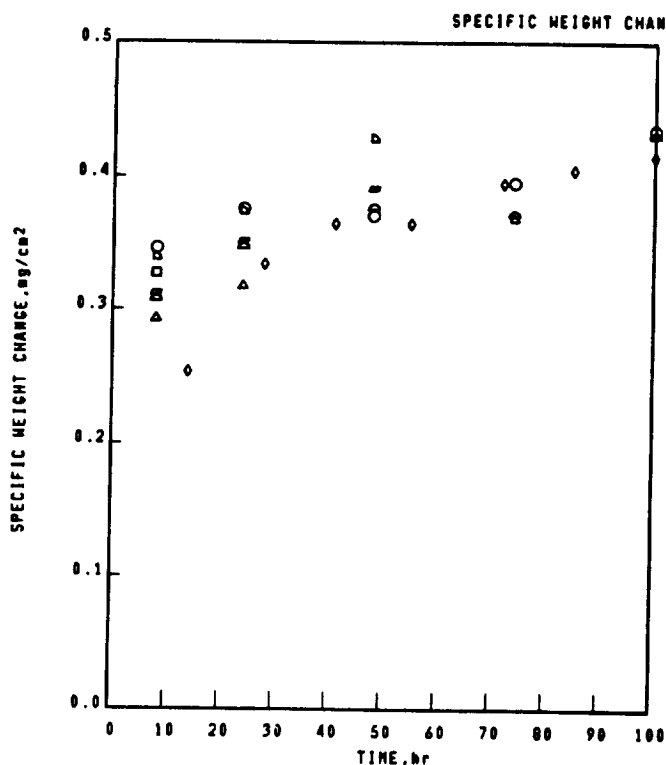
1000°C

1.00hr CYCLES

100.00hr TEST

6.500mm THICK

STATIC AIR(TN D-7404)



○ 02-04-021-005-6
 □ 02-04-021-005-1
 △ 02-04-021-005-2
 ▽ 02-04-021-005-3
 ◇ 02-04-021-005-4
 ○ 02-04-021-005-5
 ◇ 02-04-021-009-2

TIME, hr	ΔW/A, mg/cm²
0.00	0.00
8.00	0.35
24.00	0.38
48.00	0.37
74.00	0.40
100.00	0.44

TIME, hr	ΔW/A, mg/cm² 005-1
0.00	0.00
8.00	0.33

TIME, hr	ΔW/A, mg/cm² 005-2
0.00	0.00
8.00	0.29
24.00	0.32

TIME, hr	ΔW/A, mg/cm² 005-3
0.00	0.00
8.00	0.31
24.00	0.35
48.00	0.39

TIME, hr	ΔW/A, mg/cm² 005-4
0.00	0.00
8.00	0.34
24.00	0.37
48.00	0.43
74.00	0.37

TIME, hr	ΔW/A, mg/cm² 005-5
0.00	0.00
8.00	0.31
24.00	0.35
48.00	0.38
74.00	0.37
100.00	0.43

TIME, hr	ΔW/A, mg/cm² 009-2
0.00	0.00
14.00	0.25
20.00	0.33
41.00	0.36
72.00	0.40
100.00	0.42
85.00	0.36
	0.41

X-RAY DIFFRACTION DATA

SURFACE
 0 hr
 STANDARD SURFACE
 TRI(RUTILE), $d(110) \leq 3.30\text{\AA}$.
 Al_2O_3
 SPINEL, $a_0 = 0.10\text{\AA}$.

SPALL
 0 hr
 NO SIGNIFICANT SPALL OBSERVED

005-1

FACE CENTERED CUBIC MATRIX

X-RAY DIFFRACTION DATA

SURFACE
 100 hr
 STANDARD SURFACE
 TRI(RUTILE), $d(110) \leq 3.30\text{\AA}$.
 Al_2O_3
 SPINEL, $a_0 = 0.10\text{\AA}$.

SPALL
 100 hr
 NO SIGNIFICANT SPALL OBSERVED

005-5

FACE CENTERED CUBIC MATRIX

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-027-102-3

NX-188

1150°C

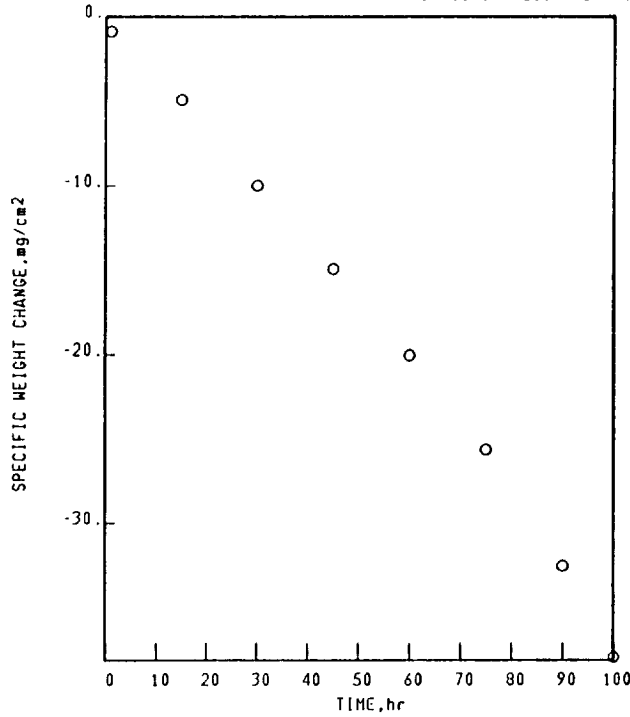
1.00hr CYCLES

100.00hr TEST

2.632mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	-0.92
15.00	-4.91
30.00	-9.99
45.00	-14.99
60.00	-20.04
75.00	-25.61
90.00	-32.53
100.00	-37.87

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-027-102-3

NX-188

1150°C

1.00hr CYCLES

100.00hr TEST

2.632mm THICK

STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

100 hr

STANDARD SURFACE

NiO

SPINEL, $a_0=8.10\text{\AA}$.

FACE CENTERED CUBIC MATRIX

SPALL

100 hr

COLLECTED SPALL

CoO

SPINEL, $a_0=8.05\text{\AA}$.

SPINEL, $a_0=8.25\text{\AA}$.

UNKNOWN LINES, d VALUES

2.66Å.

1.60Å.

0.90Å.

0.80Å.

NI BASE

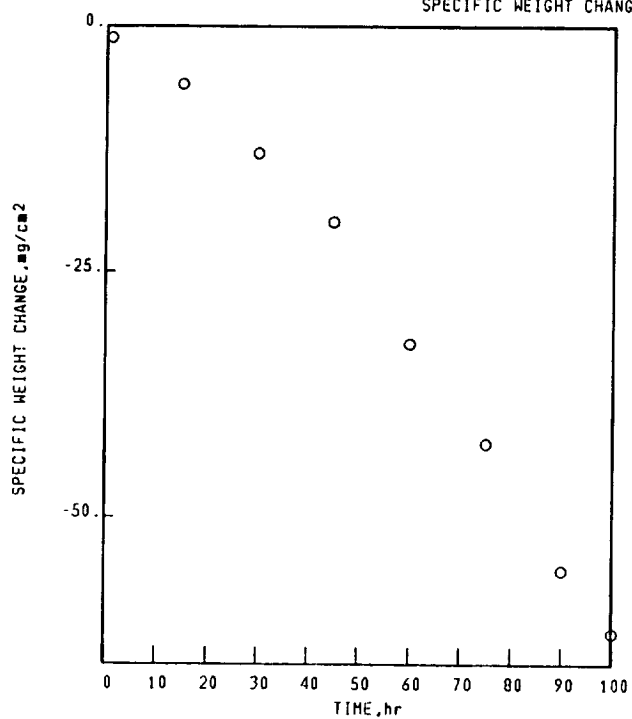
COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-027-102-6

NX-188

1150°C 1.00hr CYCLES 100.00hr TEST 2.640mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	-1.27
15.00	-6.00
30.00	-13.07
45.00	-19.93
60.00	-32.45
75.00	-42.61
90.00	-55.42
100.00	-61.88

Ni BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-027-139-4

NX-188

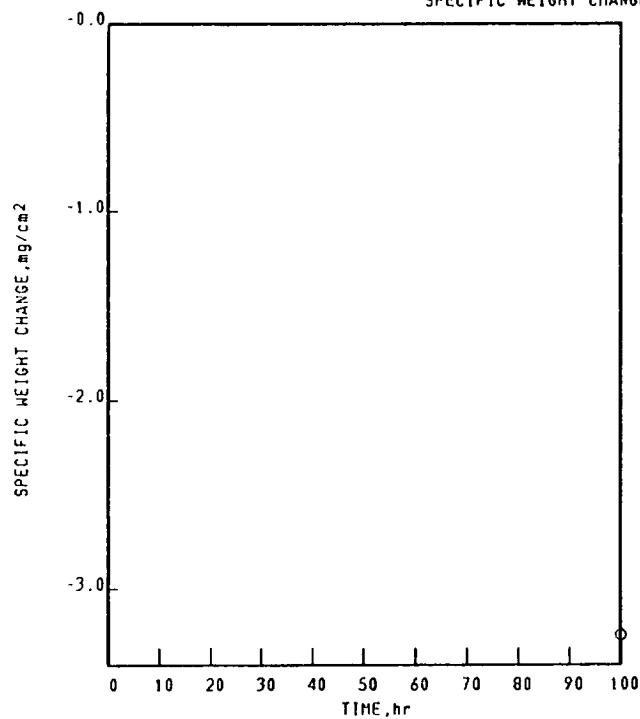
1150°C 100.00hr CYCLES

100.00hr TEST

2.662mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr
0.00
100.00

ΔW/A, mg/cm²
0.00
-3.25

Ni BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-027-139-4

NX-188

1150°C 100.00hr CYCLES

100.00hr TEST

2.662mm THICK

STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

100 hr

STANDARD SURFACE

NiO

Al₂O₃

SPINEL, a₀=8.05Å.

FACE CENTERED CUBIC MATRIX

SPALL

100 hr

COLLECTED SPALL

NiO

SPINEL, a₀=8.05Å.

Al₂O₃

Ni IN SPALL

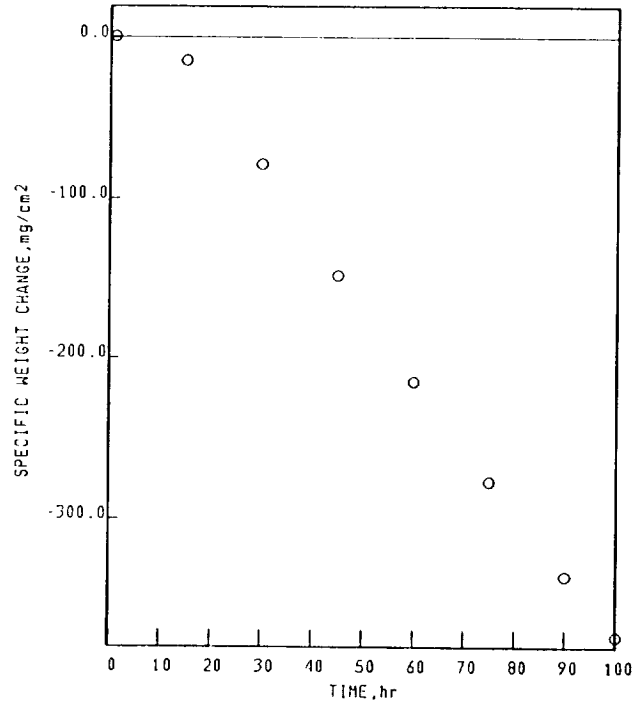
NI BASE
RENE 80

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-025-108-6

1150°C 1.00hr CYCLES 100.00hr TEST 1.807mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.57
15.00	-14.61
30.00	-78.76
45.00	-148.63
60.00	-214.87
75.00	-276.58
90.00	-336.24
100.00	-373.88

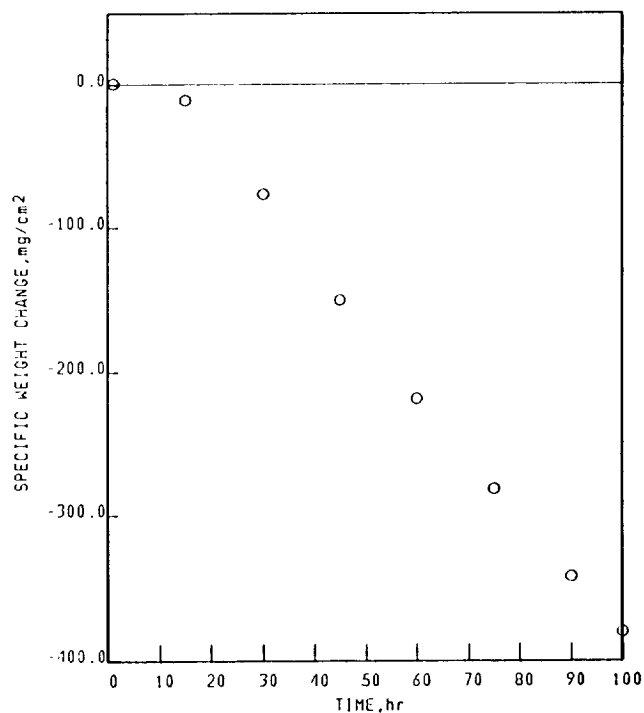
NI BASE
RENE 80

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-025-108-3

1150°C 1.00hr CYCLES 100.00hr TEST 1.750mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.51
15.00	-11.10
30.00	-76.73
45.00	-149.77
60.00	-218.91
75.00	-281.64
90.00	-341.71
100.00	-380.00

NI BASE
RENE 80

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-025-108-3

1150°C 1.00hr CYCLES 100.00hr TEST 1.750mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE
100 hr
STANDARD SURFACE
Cr₂O₃
NiO
FACE CENTERED CUBIC MATRIX

SPALL
100 hr
COLLECTED SPALL
NiO
TRT(RUTILE), d(110) ≤ 3.30Å.
TRT(RUTILE), d(110) ≤ 3.30Å.

NI BASE

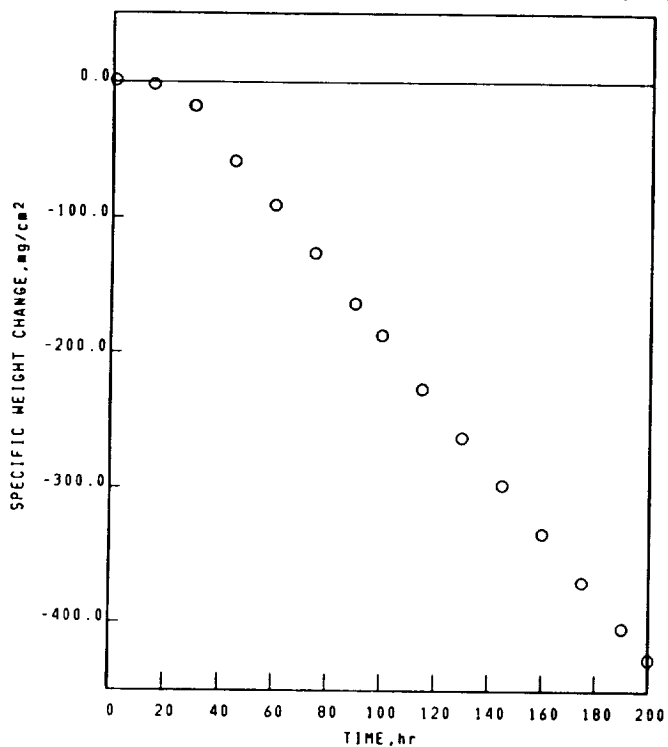
COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-025-232-3

RENE 80

1100°C 1.00hr CYCLES 200.00hr TEST 1.798mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.82
15.00	-1.81
30.00	-17.58
45.00	-58.21
60.00	-90.91
75.00	-126.57
90.00	-163.89
100.00	-187.14
115.00	-226.20
130.00	-262.37
145.00	-297.41
160.00	-333.77
175.00	-369.87
190.00	-403.87
200.00	-426.45

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-025-232-3

RENE 80

1100°C 1.00hr CYCLES 200.00hr TEST 1.798mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

200 hr

STANDARD SURFACE

Cr₂O₃

SPINEL, a₀=8.30Å.

NiO

SPALL

200 hr

COLLECTED SPALL

NiO

SPINEL, a₀=8.20Å.

FACE CENTERED CUBIC MATRIX

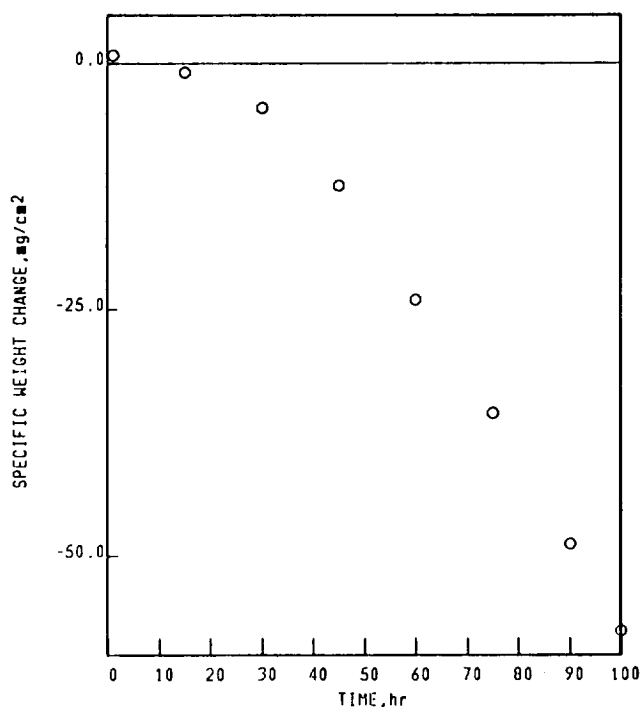
NI BASE
RENE 120

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-016-108-4

1150°C 1.00hr CYCLES 100.00hr TEST 0.795mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.84
15.00	-0.89
30.00	-4.53
45.00	-12.34
60.00	-24.03
75.00	-35.54
90.00	-48.77
100.00	-57.63

NI BASE
RENE 120

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-016-108-4

1150°C 1.00hr CYCLES 100.00hr TEST 0.795mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE
100 hr
STANDARD SURFACE
TRI(RUTILE), d(110) ≤ 3.30Å.
FACE CENTERED CUBIC MATRIX

SPALL
100 hr
COLLECTED SPALL
NiO
TRI(RUTILE), d(110) > 3.30Å.
TRI(RUTILE), d(110) ≤ 3.30Å.
TRI(RUTILE), d(110) ≤ 3.30Å.

UNKNOWN LINES, d VALUES
2.89Å.
3.69Å.
2.95Å.
1.75Å.

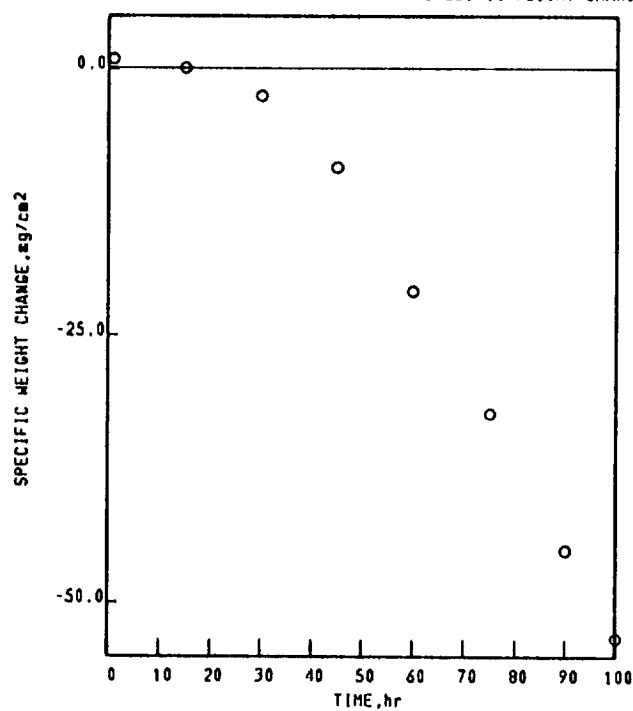
NI BASE
RENE 120

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-016-108-5

1150°C 1.00hr CYCLES 100.00hr TEST 0.733mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.87
15.00	0.04
30.00	-2.59
45.00	-9.34
60.00	-20.85
75.00	-32.35
90.00	-45.07
100.00	-53.30

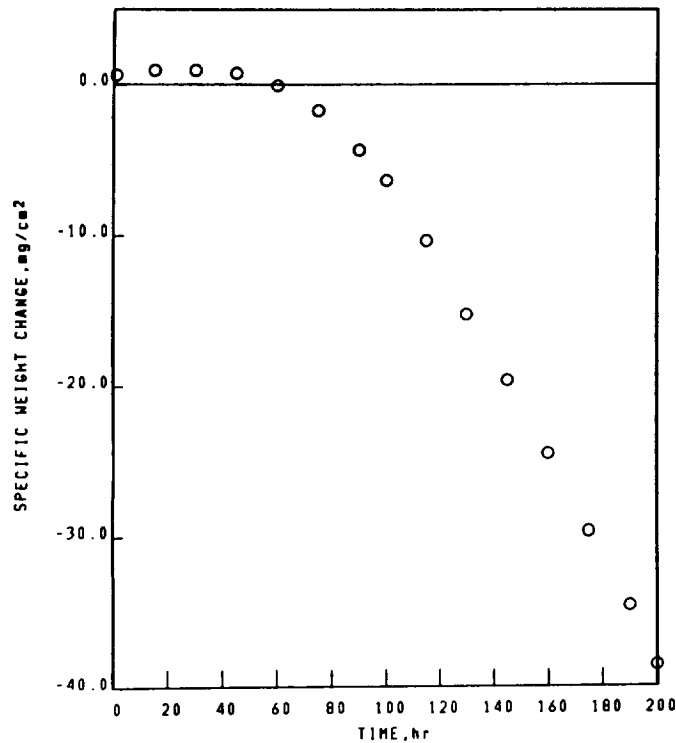
NI BASE
RENE 120

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-016-232-6

1100°C 1.00hr CYCLES 200.00hr TEST 0.800mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.64
15.00	0.96
30.00	0.96
45.00	0.76
60.00	-0.05
75.00	-1.74
90.00	-4.36
100.00	-6.38
115.00	-10.36
130.00	-15.23
145.00	-19.63
160.00	-24.54
175.00	-29.68
190.00	-34.61
200.00	-38.57

NI BASE
RENE 120

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-016-232-6

1100°C 1.00hr CYCLES 200.00hr TEST 0.800mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE
200 hr
STANDARD SURFACE
SPINEL, $a_0=0.15\text{\AA}$.
TRI(RUTILE).d(110) $\leq 3.30\text{\AA}$.
Cr₂O₃

FACE CENTERED CUBIC MATRIX

SPALL
200 hr
COLLECTED SPALL
NiO
SPINEL, $a_0=0.20\text{\AA}$.
TRI(RUTILE).d(110) $\leq 3.30\text{\AA}$.

02-04-017-322-4

STATIC AIR

A scatter plot showing the specific weight change (in mg/cm²) over time (in hours) for a 100% relative humidity environment. The y-axis is labeled 'SPECIFIC WEIGHT CHANGE, mg/cm²' and ranges from 0.0 to -30.0. The x-axis is labeled 'TIME, hr' and ranges from 0 to 100. The data points show a clear downward trend, indicating a decrease in specific weight over time.

TIME, hr	SPECIFIC WEIGHT CHANGE, mg/cm²
0	0.0
15	-1.5
28	-3.0
45	-6.5
58	-11.0
75	-18.0
90	-27.0
98	-35.0

TIME, hr	$\Delta H/A, \text{mg/cm}^2$
0.00	0.00
1.00	0.48
15.00	-0.91
30.00	-2.19
45.00	-5.47
60.00	-10.55
75.00	-17.57
90.00	-26.65
100.00	-34.69

02-04-017-322-4

STATIC AIR

SURFACE	SPALL
100 hr	100 hr
STANDARD SURFACE	COLLECTED SPALL
SPINEL, $a_0 = 8.10\text{\AA}$.	NiO
TRI(RUTILE), $d(110) \leq 3.30\text{\AA}$.	Ni(W,Mo)O ₄ TYPE 2
SPINEL, $a_0 = 8.25\text{\AA}$.	SPINEL, $a_0 = 8.30\text{\AA}$.
Al ₂ O ₃	TRI(RUTILE), $d(110) \leq 3.30\text{\AA}$.
HfO ₂	
	UNKNOWN LINES, d VALUES
FACE CENTERED CUBIC MATRIX	3.14\AA.
	4.97\AA.
	4.38\AA.

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-017-325-4

RENE 125

1100°C

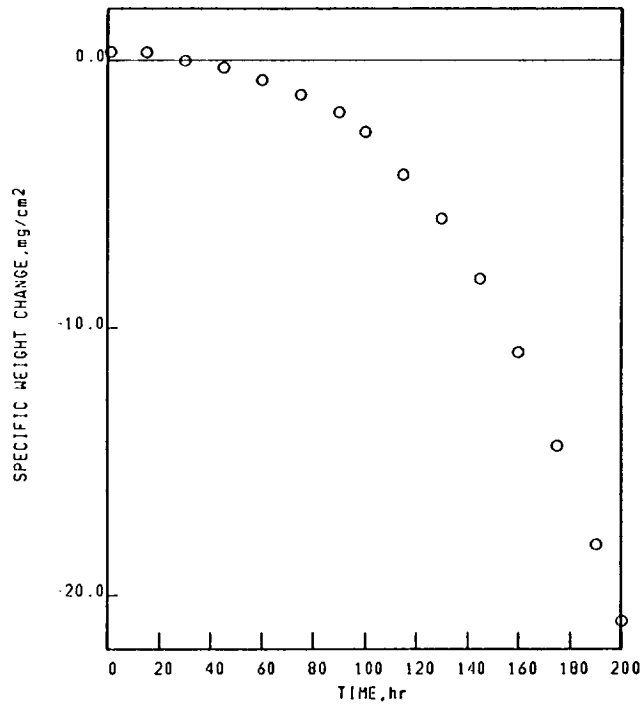
1.00hr CYCLES

200.00hr TEST

2.341mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.33
15.00	0.31
30.00	-0.01
45.00	-0.27
60.00	-0.74
75.00	-1.29
90.00	-1.94
100.00	-2.68
115.00	-4.28
130.00	-5.90
145.00	-8.15
160.00	-10.93
175.00	-14.43
190.00	-18.09
200.00	-20.97

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-017-325-4

RENE 125

1100°C

1.00hr CYCLES

200.00hr TEST

2.341mm THICK

STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE
200 hr
STANDARD SURFACE
SPINEL, $a_0=8.25\text{\AA}$.
SPINEL, $a_0=8.10\text{\AA}$.
TRI(RUTILE), $d(110)\leq 3.30\text{\AA}$.
Ni(W,Mo)O₄ TYPE 1
Cr₂O₃
HfO₂
FACE CENTERED CUBIC MATRIX

SPALL
200 hr
COLLECTED SPALL
NiO
Ni(W,Mo)O₄ TYPE 1
TRI(RUTILE), $d(110)\leq 3.30\text{\AA}$.
SPINEL, $a_0=8.30\text{\AA}$.

Ni BASE

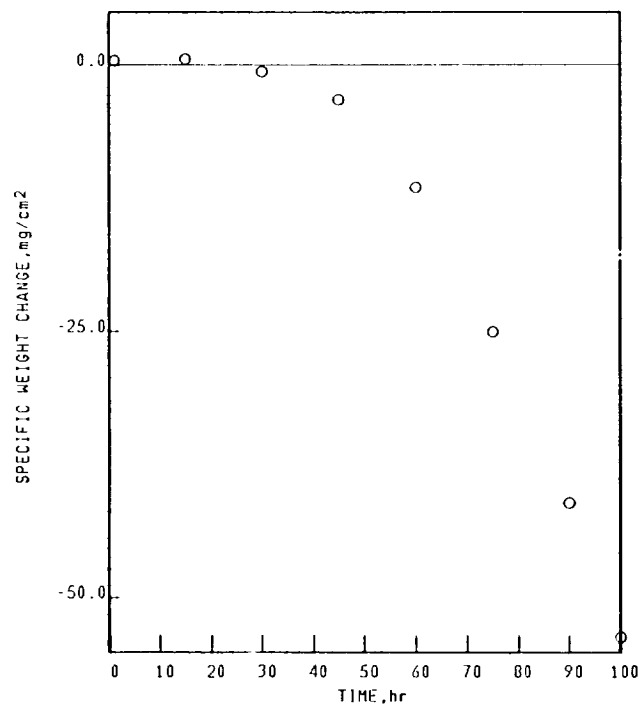
EXPERIMENTAL HOT WORKED GAMMA/GAMMA PRIME ALLOYS

02-04-019-101-1

TAZ-8A

1150°C 1.00hr CYCLES 100.00hr TEST 1.657mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.40
15.00	0.58
30.00	-0.60
45.00	-3.25
60.00	-11.55
75.00	-25.05
90.00	-41.11
100.00	-53.65

Ni BASE

EXPERIMENTAL HOT WORKED GAMMA/GAMMA PRIME ALLOYS

02-04-019-101-2

TAZ-8A

1150°C

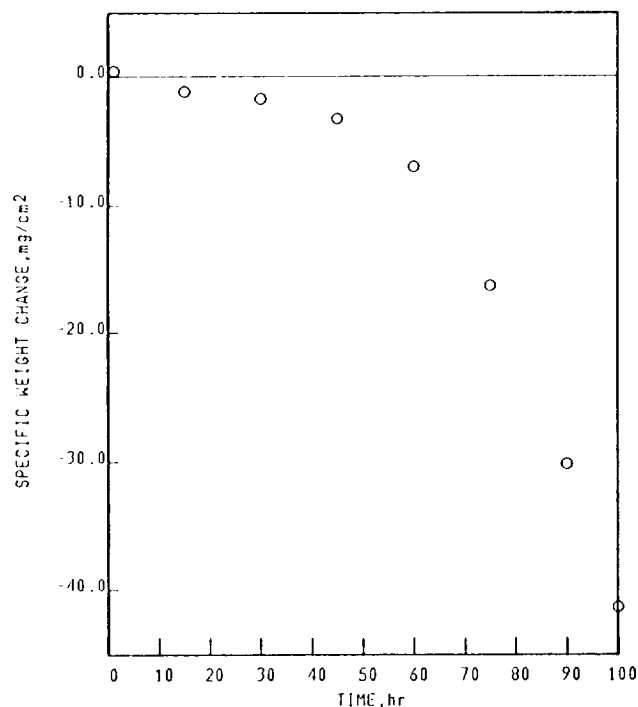
1.00hr CYCLES

100.00hr TEST

1.680mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.41
15.00	-1.15
30.00	-1.69
45.00	-3.21
60.00	-6.97
75.00	-16.33
90.00	-30.15
100.00	-41.34

Ni BASE

EXPERIMENTAL HOT WORKED GAMMA/GAMMA PRIME ALLOYS

02-04-019-101-2

TAZ-8A

1150°C

1.00hr CYCLES

100.00hr TEST

1.680mm THICK

STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

100 hr

STANDARD SURFACE

TRI(RUTILE), d(110) ≤ 3.30Å.

Al₂O₃

SPINEL, a₀ = 8.10Å.

FACE CENTERED CUBIC MATRIX

SPALL

100 hr

COLLECTED SPALL

NiO

TRI(RUTILE), d(110) ≤ 3.30Å.

Ni BASE

EXPERIMENTAL HOT WORKED GAMMA/GAMMA PRIME ALLOYS

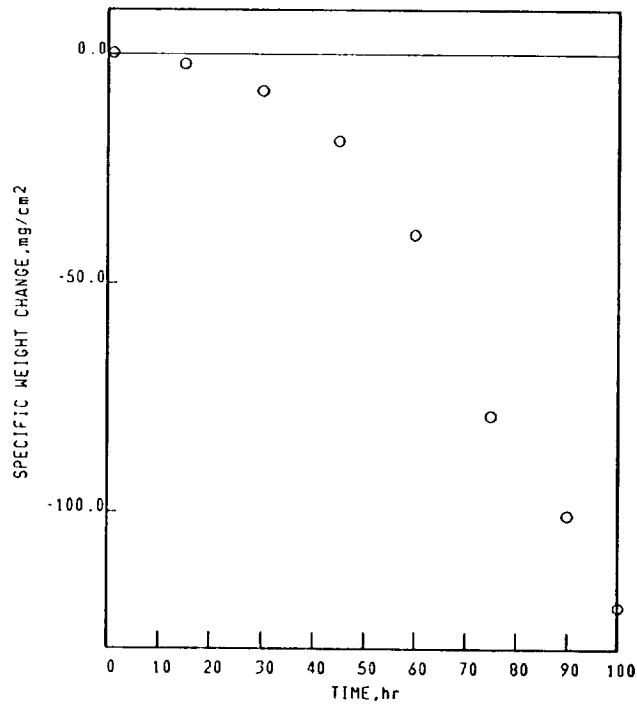
02-04-019-107-3

TAZ-8A

1150°C 1.00hr CYCLES 100.00hr TEST 2.433mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.23
15.00	-2.17
30.00	-8.10
45.00	-19.04
60.00	-39.37
75.00	-79.07
90.00	-100.63
100.00	-120.87

Ni BASE

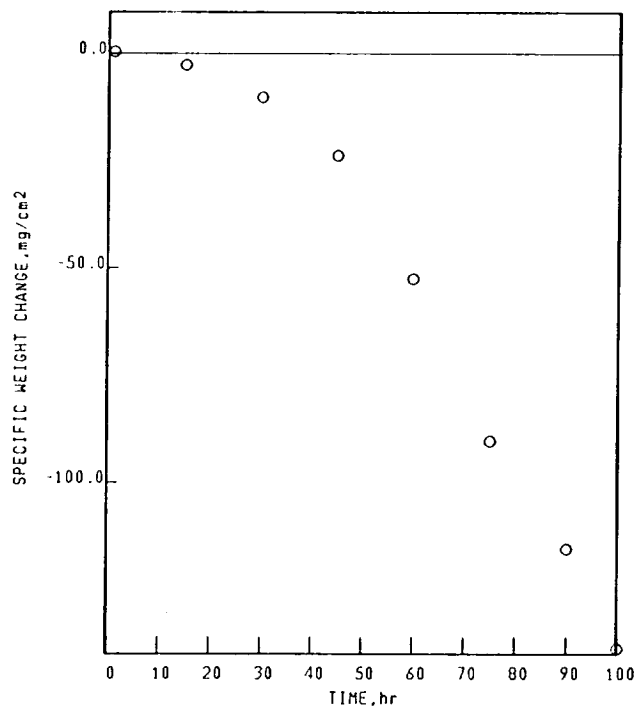
EXPERIMENTAL HOT WORKED GAMMA/GAMMA PRIME ALLOYS

02-04-019-107-6

TAZ-8A

1150°C 1.00hr CYCLES 100.00hr TEST 2.415mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.36
15.00	-2.73
30.00	-10.30
45.00	-23.84
60.00	-52.53
75.00	-90.48
90.00	-115.44
100.00	-138.95

Ni BASE

EXPERIMENTAL HOT WORKED GAMMA/GAMMA PRIME ALLOYS

02-04-019-107-6

TAZ-8A

1150°C 1.00hr CYCLES 100.00hr TEST 2.415mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE	SPALL
100 hr	100 hr
STANDARD SURFACE	COLLECTED SPALL
NiO	NiO
TRI(RUTILE), d(110) ≤ 3.30Å.	TRI(RUTILE), d(110) ≤ 3.30Å.
SPINEL, a₀ = 0.25Å.	TRI(RUTILE), d(110) ≤ 3.30Å.
FACE CENTERED CUBIC MATRIX	UNKNOWN LINES, d VALUES
	2.88Å.

Ni BASE

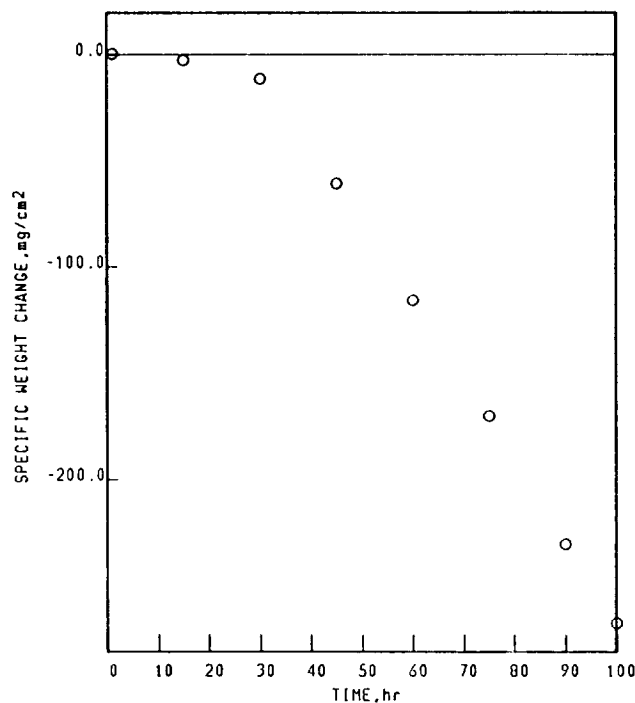
EXPERIMENTAL HOT WORKED GAMMA/GAMMA PRIME ALLOYS

02-04-019-204-6

TAZ-8A

1150°C 1.00hr CYCLES 100.00hr TEST 2.427mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.22
15.00	-2.59
30.00	-11.50
45.00	-60.93
60.00	-115.32
75.00	-169.79
90.00	-230.20
100.00	-266.94

Ni BASE

EXPERIMENTAL HOT WORKED GAMMA/GAMMA PRIME ALLOYS

02-04-019-204-6

TAZ-8A

1150°C 1.00hr CYCLES 100.00hr TEST 2.427mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

100 hr

STANDARD SURFACE

TR(RUTILE), d(110) > 3.30A.

NiO

SPINEL, a₀ = 8.25A.

SPALL

100 hr

COLLECTED SPALL

NiO

NiO

TR(RUTILE), d(110) > 3.30A.

TR(RUTILE), d(110) ≤ 3.30A.

Al₂O₃

UNKNOWN LINES, d VALUES

4.63A.

1.17A.

1.12A.

1.06A.

Ni BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-019-321-3

TAZ-BA

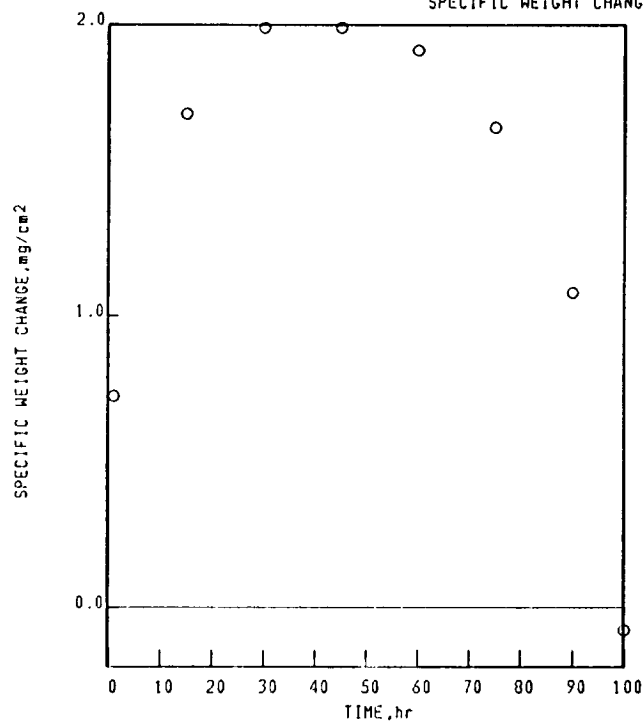
1150°C

1.00hr CYCLES

100.00hr TEST 2.315mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.72
15.00	1.69
30.00	1.99
45.00	1.99
60.00	1.91
75.00	1.65
90.00	1.08
100.00	-0.08

Ni BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-019-321-3

TAZ-BA

1150°C

1.00hr CYCLES

100.00hr TEST 2.315mm THICK

STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE
100 hr
STANDARD SURFACE
SPINEL, $a_0=8.10\text{\AA}$.
TRI(RUTILE), $d(110)>3.30\text{\AA}$.
NiO
 Al_2O_3
 ZrO_2
FACE CENTERED CUBIC MATRIX

SPALL
100 hr
COLLECTED SPALL
NiO
TRI(RUTILE), $d(110)>3.30\text{\AA}$.
SPINEL, $a_0=8.10\text{\AA}$.
SPINEL, $a_0=8.25\text{\AA}$.
Ni(W,Mo)O₄ TYPE 1
UNKNOWN LINES, d VALUES
2.96Å.

NI BASE

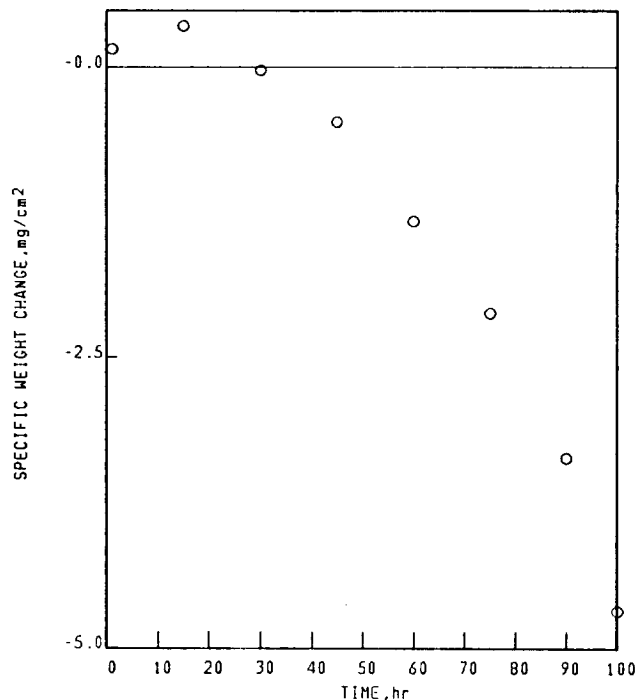
EXPERIMENTAL HOT WORKED GAMMA/GAMMA PRIME ALLOYS

02-04-019-115-1

TAZ-8A

1100°C 1.00hr CYCLES 100.00hr TEST 2.434mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.16
15.00	0.36
30.00	-0.03
45.00	-0.48
60.00	-1.32
75.00	-2.12
90.00	-3.37
100.00	-4.68

NI BASE

EXPERIMENTAL HOT WORKED GAMMA/GAMMA PRIME ALLOYS

02-04-019-115-1

TAZ-8A

1100°C 1.00hr CYCLES 100.00hr TEST 2.434mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

100 hr

STANDARD SURFACE

SPINEL, $a_0=8.10\text{\AA}$.

TRI(RUTILE), $d(110)\leq 3.30\text{\AA}$.

Al_2O_3

NiO

SPINEL, $a_0=8.25\text{\AA}$.

FACE CENTERED CUBIC MATRIX

SPALL

100 hr

COLLECTED SPALL

NiO

TRI(RUTILE), $d(110)\leq 3.30\text{\AA}$.

SPINEL, $a_0=8.10\text{\AA}$.

Al_2O_3

SPINEL, $a_0=8.25\text{\AA}$.

NI BASE

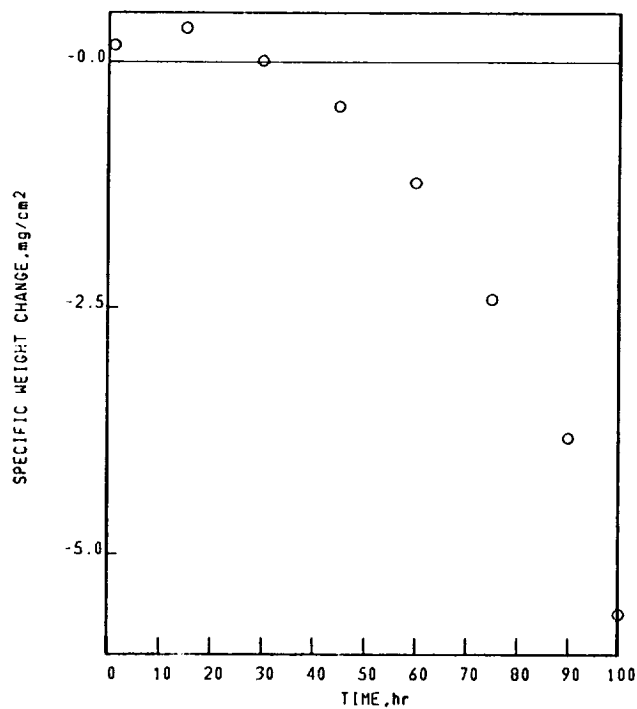
EXPERIMENTAL HOT WORKED GAMMA/GAMMA PRIME ALLOYS

02-04-019-115-2

TAZ-8A

1100°C 1.00hr CYCLES 100.00hr TEST 2.434mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.17
15.00	0.34
30.00	0.01
45.00	-0.45
60.00	-1.23
75.00	-2.42
90.00	-3.81
100.00	-5.59

NI BASE

EXPERIMENTAL HOT WORKED GAMMA/GAMMA PRIME ALLOYS

02-04-019-190-1

TAZ-8A

1100°C

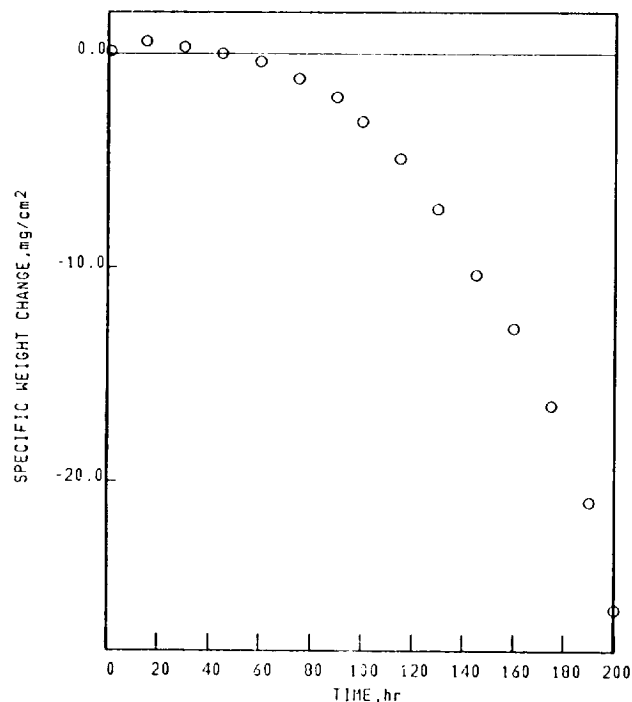
1.00hr CYCLES

200.00hr TEST

2.831mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.12
15.00	0.59
30.00	0.33
45.00	0.01
60.00	-0.36
75.00	-1.15
90.00	-2.03
100.00	-3.16
115.00	-4.87
130.00	-7.22
145.00	-10.34
160.00	-12.88
175.00	-16.51
190.00	-20.97
200.00	-26.08

NI BASE

EXPERIMENTAL HOT WORKED GAMMA/GAMMA PRIME ALLOYS

02-04-019-190-1

TAZ-8A

1100°C

1.00hr CYCLES

200.00hr TEST

2.831mm THICK

STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

200 hr

STANDARD SURFACE

SPINEL, $a_0 = 0.15A$.

Al_2O_3

TRT(RUTILE), $d(110) \leq 3.30A$.

FACE CENTERED CUBIC MATRIX

SPALL

200 hr

PROBABLE CROSS-SPALL

Fe_2O_3

Ni BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-019-324-3

TAZ-8A

1100°C

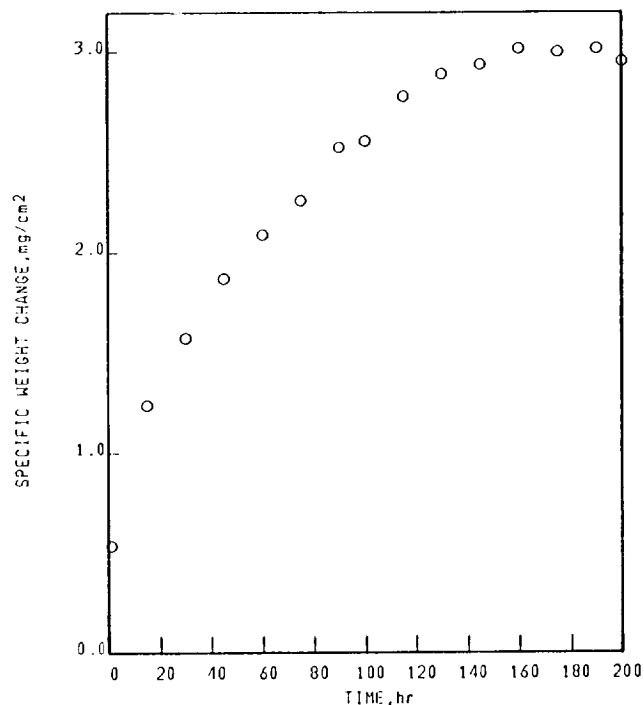
1.00hr CYCLES

200.00hr TEST

2.315mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.53
15.00	1.24
30.00	1.57
45.00	1.87
60.00	2.09
75.00	2.26
90.00	2.53
100.00	2.56
115.00	2.78
130.00	2.89
145.00	2.94
160.00	3.01
175.00	3.00
190.00	3.01
200.00	2.95

Ni BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-019-324-3

TAZ-8A

1100°C

1.00hr CYCLES

200.00hr TEST

2.315mm THICK

STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE
200 hr
STANDARD SURFACE
SPINEL, $a_0 = 8.10\text{\AA}$.
TRI(RUTILE), $d(110) > 3.30\text{\AA}$.
NiO
Ni(W,Mo)O₄ TYPE 1
Al₂O₃
FACE CENTERED CUBIC MATRIX

SPALL
200 hr
COLLECTED SPALL
NiO
Ni(W,Mo)O₄ TYPE 1
SPINEL, $a_0 = 8.25\text{\AA}$.
SPINEL, $a_0 = 8.05\text{\AA}$.
TRI(RUTILE), $d(110) > 3.30\text{\AA}$.
Al₂O₃
Ni(W,Mo)O₄ TYPE 2
3.57\text{\AA}.

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-032-322-2

TRW-R

1150°C

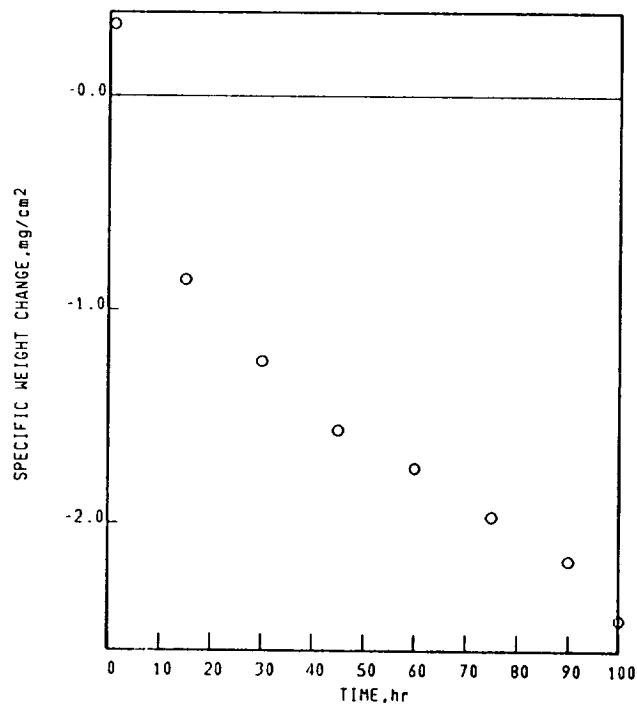
1.00hr CYCLES

100.00hr TEST

2.338mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.34
15.00	-0.86
30.00	-1.24
45.00	-1.57
60.00	-1.75
75.00	-1.97
90.00	-2.17
100.00	-2.46

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-032-322-2

TRW-R

1150°C

1.00hr CYCLES

100.00hr TEST

2.338mm THICK

STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

100 hr

STANDARD SURFACE

SPINEL, $a_0 = 8.10 \text{ \AA}$.

Al_2O_3

Ti(RUTILE) , $d(110) \leq 3.30 \text{ \AA}$.

HfO_2

FACE CENTERED CUBIC MATRIX

SPALL

100 hr

COLLECTED SPALL

NiO

SPINEL, $a_0 = 8.30 \text{ \AA}$.

Ti(RUTILE) , $d(110) \leq 3.30 \text{ \AA}$.

SPINEL, $a_0 = 8.10 \text{ \AA}$.

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

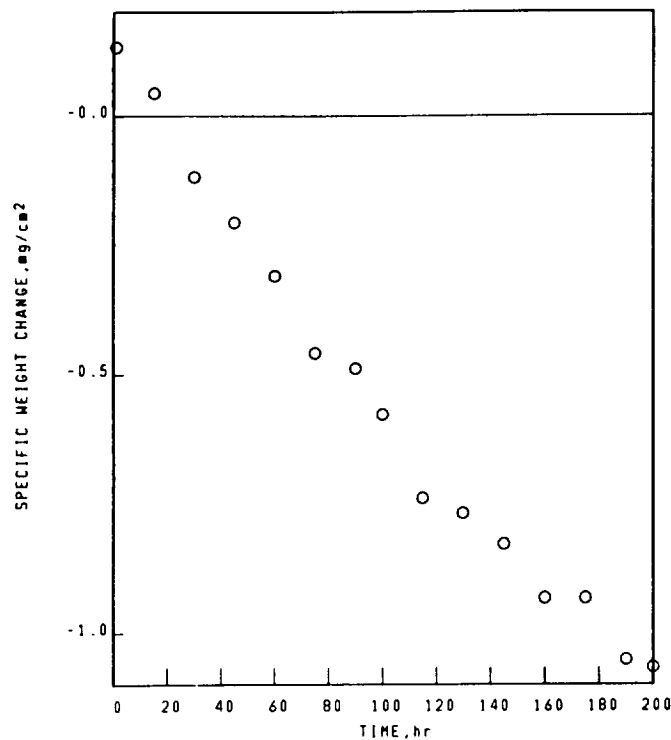
02-04-032-325-2

TRW-R

1100°C 1.00hr CYCLES 200.00hr TEST 2.335mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.13
15.00	0.04
30.00	-0.12
45.00	-0.21
60.00	-0.31
75.00	-0.46
90.00	-0.49
100.00	-0.58
115.00	-0.74
130.00	-0.77
145.00	-0.83
160.00	-0.93
175.00	-0.93
190.00	-1.05
200.00	-1.07

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-032-325-2

TRW-R

1100°C 1.00hr CYCLES 200.00hr TEST 2.335mm THICK

STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE
200 hr
STANDARD SURFACE
SPINEL, $a_0 = 8.10\text{\AA}$.
 Al_2O_3
TRI(RUTILE), $d(110) \leq 3.30\text{\AA}$.
 HfO_2
FACE CENTERED CUBIC MATRIX

SPALL
200 hr
COLLECTED SPALL
 NiO
SPINEL, $a_0 = 8.30\text{\AA}$.
TRI(RUTILE), $d(110) \leq 3.30\text{\AA}$.
SPINEL, $a_0 = 8.05\text{\AA}$.
 Cr_2O_3
 Al_2O_3

UNKNOWN LINES, d VALUES
2.70\AA.

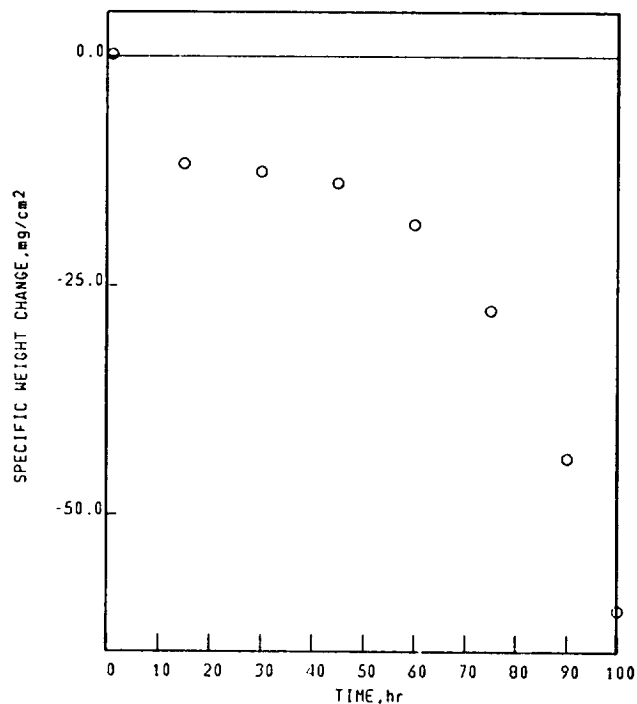
Ni BASE
UDIMET-700

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-022-321-6

1150°C 1.00hr CYCLES 100.00hr TEST 2.310mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	$\Delta W/A, \text{mg/cm}^2$
0.00	0.00
1.00	0.23
15.00	-11.64
30.00	-12.50
45.00	-13.72
60.00	-18.25
75.00	-27.74
90.00	-43.79
100.00	-60.56

Ni BASE
UDIMET-700

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-022-321-6

1150°C 1.00hr CYCLES 100.00hr TEST 2.310mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE
100 hr
STANDARD SURFACE
SPINEL, $a_0=8.25\text{\AA}$.
SPINEL, $a_0=8.10\text{\AA}$.
 NiTiO_3
 Cr_2O_3
 Al_2O_3
 $\text{Ti}(\text{RUTILE}), d(110) \leq 3.30\text{\AA}$.
FACE CENTERED CUBIC MATRIX

SPALL
100 hr
COLLECTED SPALL
 NiO
SPINEL, $a_0=8.25\text{\AA}$.
 $\text{Ni}(\text{W,Mo})\text{O}_4$ TYPE 2
 Cr_2O_3

NI BASE

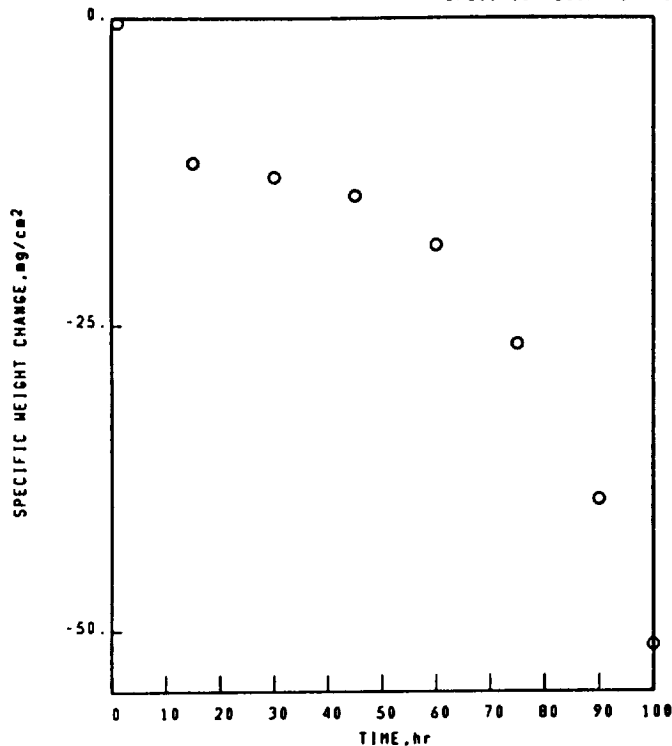
COMMERCIAL HOT WORKED GAMMA/GAMMA PRIME ALLOYS

02-13-016-323-6

U-700

1150°C 1.00hr CYCLES 100.00hr TEST 1.760mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	-0.38
15.00	-11.04
30.00	-13.00
45.00	-14.53
60.00	-18.51
75.00	-26.57
90.00	-39.37
100.00	-51.14

NI BASE

COMMERCIAL HOT WORKED GAMMA/GAMMA PRIME ALLOYS

02-13-016-323-6

U-700

1150°C 1.00hr CYCLES 100.00hr TEST 1.760mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

100 hr

STANDARD SURFACE

SPINEL, $a_0 = 0.30A$.

SPINEL, $a_0 = 0.10A$.

NiO

Cr₂O₃

(Ni,Co,Fe)TiO₃

Al₂O₃

TRI(RUTILE), $d(110) \leq 0.30A$.

FACE CENTERED CUBIC MATRIX

SPALL

100 hr

COLLECTED SPALL

NiO

SPINEL, $a_0 = 0.30A$.

Ni BASE

EXPERIMENTAL HOT WORKED GAMMA/GAMMA PRIME ALLOYS

02-04-022-251-1

U-700

1100°C

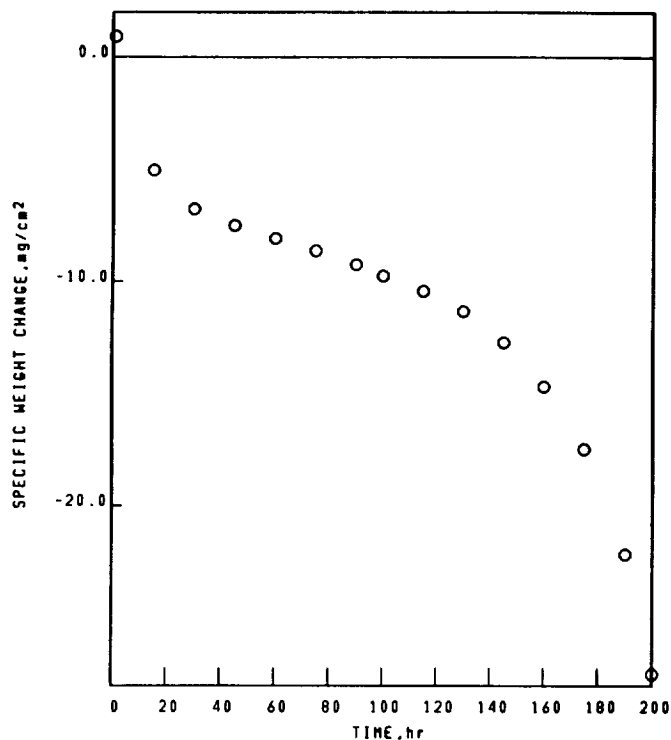
1.00hr CYCLES

200.00hr TEST

1.752mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.91
15.00	-5.01
30.00	-6.74
45.00	-7.48
60.00	-8.07
75.00	-8.63
90.00	-9.24
100.00	-9.75
115.00	-10.43
130.00	-11.34
145.00	-12.73
160.00	-14.66
175.00	-17.45
190.00	-22.17
200.00	-27.48

Ni BASE

EXPERIMENTAL HOT WORKED GAMMA/GAMMA PRIME ALLOYS

02-04-022-251-1

U-700

1100°C

1.00hr CYCLES

200.00hr TEST

1.752mm THICK

STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

200 hr

STANDARD SURFACE

SPINEL, $a_0 = 0.15A$.

TRI(RUTILE), $d(110) \leq 3.30A$.

Al_2O_3

TRI(RUTILE), $d(110) \leq 3.30A$.

FACE CENTERED CUBIC MATRIX

SPALL

200 hr

COLLECTED SPALL

NiO

SPINEL, $a_0 = 0.25A$.

Cr_2O_3

TRI(RUTILE), $d(110) \leq 3.30A$.

$Ni(H,Mo)O_4$ TYPE 1

NI BASE

EXPERIMENTAL HOT WORKED GAMMA/GAMMA PRIME ALLOYS

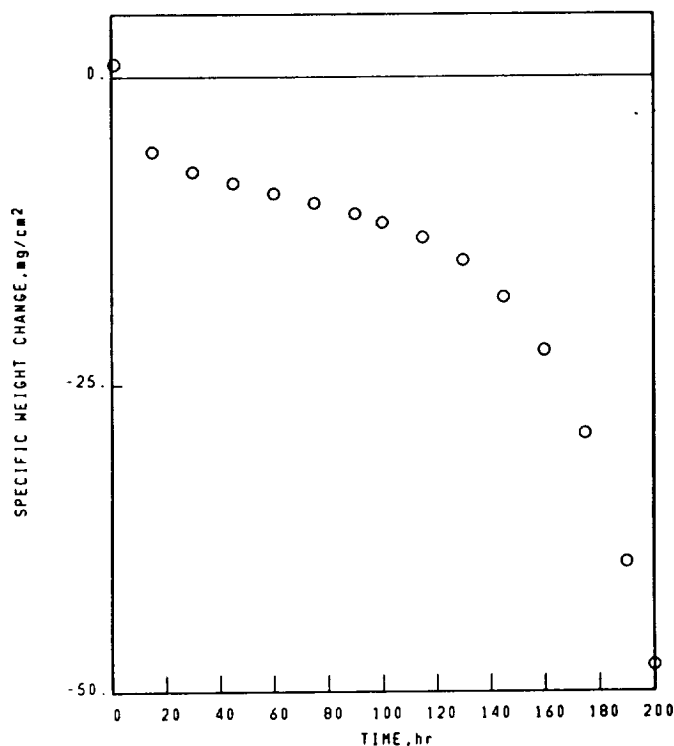
02-04-022-251-2

U-700

1100°C 1.00hr CYCLES 200.00hr TEST 1.756mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	1.02
15.00	-6.06
30.00	-7.68
45.00	-8.62
60.00	-9.48
75.00	-10.25
90.00	-11.13
100.00	-11.87
115.00	-13.10
130.00	-14.97
145.00	-17.99
160.00	-22.29
175.00	-29.02
190.00	-39.52
200.00	-47.83

NI BASE

EXPERIMENTAL HOT WORKED GAMMA/GAMMA PRIME ALLOYS

02-04-022-251-2

U-700

1100°C 1.00hr CYCLES 200.00hr TEST 1.756mm THICK

STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

200 hr

STANDARD SURFACE

SPINEL, $a_0 = 8.15\text{\AA}$.

TR1(RUTILE), $d(110) \leq 3.30\text{\AA}$.

Al_2O_3

TR1(RUTILE), $d(110) \leq 3.30\text{\AA}$.

Cr_2O_3

FACE CENTERED CUBIC MATRIX

SPALL

200 hr

COLLECTED SPALL

NiO

SPINEL, $a_0 = 8.25\text{\AA}$.

TR1(RUTILE), $d(110) \leq 3.30\text{\AA}$.

Cr_2O_3

$\text{Ni}(\text{W},\text{Mo})\text{O}_4$ TYPE 1

NI BASE

EXPERIMENTAL HOT WORKED GAMMA/GAMMA PRIME ALLOYS

02-04-022-266-1

U-700

1100°C

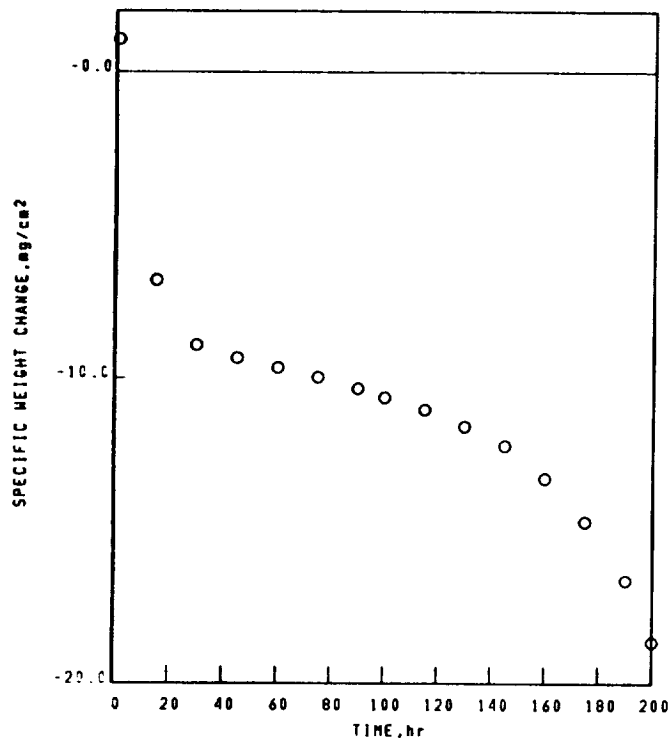
1.00hr CYCLES

200.00hr TEST

1.729mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	1.07
15.00	-6.76
30.00	-8.91
45.00	-9.33
60.00	-9.65
75.00	-9.96
90.00	-10.34
100.00	-10.63
115.00	-11.03
130.00	-11.58
145.00	-12.20
160.00	-13.24
175.00	-14.66
190.00	-16.61
200.00	-18.64

Ni BASE

EXPERIMENTAL HOT WORKED GAMMA/GAMMA PRIME ALLOYS

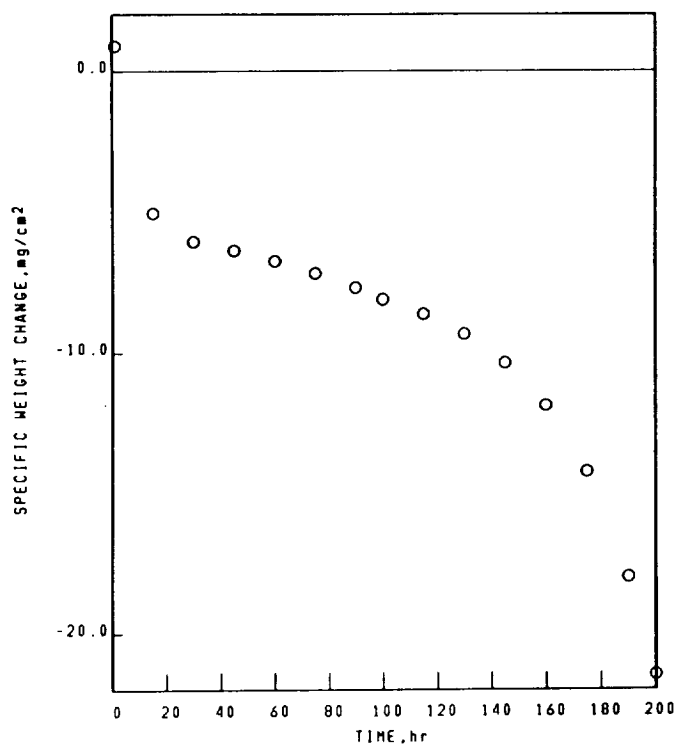
02-04-022-269-1

U-700

1100°C 1.00hr CYCLES 200.00hr TEST 1.732mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.89
15.00	-5.06
30.00	-6.07
45.00	-6.39
60.00	-6.78
75.00	-7.20
90.00	-7.71
100.00	-8.11
115.00	-8.62
130.00	-9.33
145.00	-10.37
160.00	-11.89
175.00	-14.28
190.00	-18.03
200.00	-21.46

Ni BASE

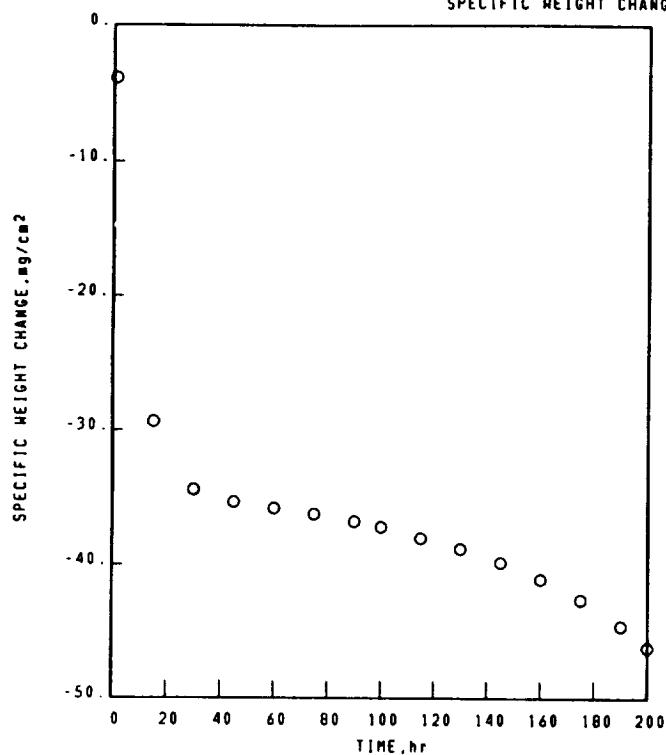
EXPERIMENTAL HOT WORKED GAMMA/GAMMA PRIME ALLOYS

02-13-016-310-6

U-700

1100°C 1.00hr CYCLES 200.00hr TEST 1.762mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	$\Delta W/A, \text{mg/cm}^2$
0.00	0.00
1.00	-3.89
15.00	-29.37
30.00	-34.39
45.00	-35.31
60.00	-35.78
75.00	-36.23
90.00	-36.76
100.00	-37.17
115.00	-38.00
130.00	-38.79
145.00	-39.83
160.00	-41.06
175.00	-42.65
190.00	-44.59
200.00	-46.18

Ni BASE

EXPERIMENTAL HOT WORKED GAMMA/GAMMA PRIME ALLOYS

02-13-016-310-6

U-700

1100°C 1.00hr CYCLES 200.00hr TEST 1.762mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

200 hr

STANDARD SURFACE

SPINEL, $a_0 = 0.10\text{\AA}$. Al_2O_3 TRIL(RUTILE), $d(110) \leq 3.30\text{\AA}$.

FACE CENTERED CUBIC MATRIX

SPALL

200 hr

COLLECTED SPALL

NiO

SPINEL, $a_0 = 0.25\text{\AA}$.UNKNOWN LINES, d VALUES

3.09\text{\AA}.

2.44\text{\AA}.

Ni BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

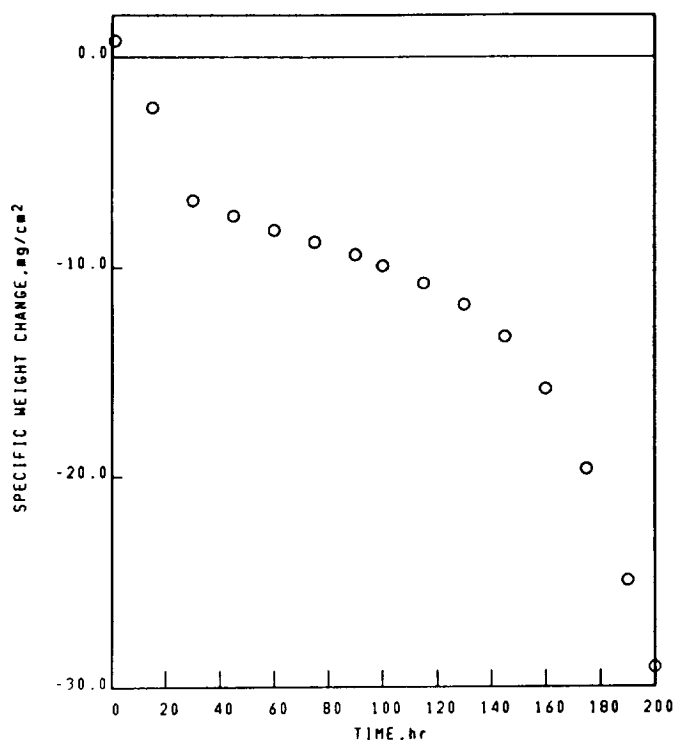
02-04-022-324-6

U-700

1100°C 1.00hr CYCLES 200.00hr TEST 2.308mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.77
15.00	-2.42
30.00	-6.86
45.00	-7.61
60.00	-8.28
75.00	-8.84
90.00	-9.42
100.00	-9.95
115.00	-10.77
130.00	-11.79
145.00	-13.32
160.00	-15.83
175.00	-19.67
190.00	-24.92
200.00	-29.06

Ni BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-022-324-6

U-700

1100°C 1.00hr CYCLES 200.00hr TEST 2.308mm THICK

STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

200 hr

STANDARD SURFACE

SPINEL, $a_0 = 0.10A$.

NiO

SPINEL, $a_0 = 0.25A$.(Ni,Co,Fe)TiO₃Cr₂O₃TRT(RUTILE), $d(110) \leq 3.30A$.

FACE CENTERED CUBIC MATRIX

SPALL

200 hr

COLLECTED SPALL

NiO

SPINEL, $a_0 = 0.30A$.Cr₂O₃(Ni,Co,Fe)TiO₃Al₂O₃UNKNOWN LINES, d VALUES

3.10A.

NI BASE

COMMERCIAL HOT WORKED GAMMA/GAMMA PRIME ALLOYS

02-13-016-326-6

U-700

1100°C

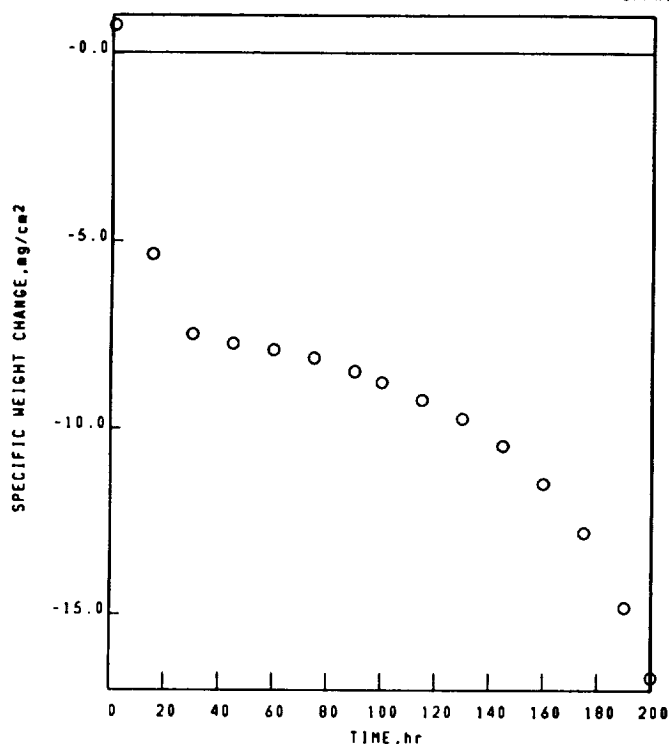
1.00hr CYCLES

200.00hr TEST

1.748mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.73
15.00	-5.35
30.00	-7.50
45.00	-7.75
60.00	-7.92
75.00	-8.14
90.00	-8.48
100.00	-8.74
115.00	-9.24
130.00	-9.73
145.00	-10.45
160.00	-11.47
175.00	-12.80
190.00	-14.80
200.00	-16.65

NI BASE

COMMERCIAL HOT WORKED GAMMA/GAMMA PRIME ALLOYS

02-13-016-326-6

U-700

1100°C

1.00hr CYCLES

200.00hr TEST

1.748mm THICK

STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

200 hr

STANDARD SURFACE

SPINEL, $a_0 = 0.15A$.

SPINEL, $a_0 = 0.30A$.

(Ni,Co,Fe)TiO₃

Cr₂O₃

TRI(RUTILE), $d(110) \leq 3.30A$.

Al₂O₃

FACE CENTERED CUBIC MATRIX

SPALL

200 hr

COLLECTED SPALL

SPINEL, $a_0 = 0.30A$.

NiO

Ni(W,Mo)O₄ TYPE 1

TRI(RUTILE), $d(110) \leq 3.30A$.

(Ni,Co,Fe)TiO₃

Cr₂O₃

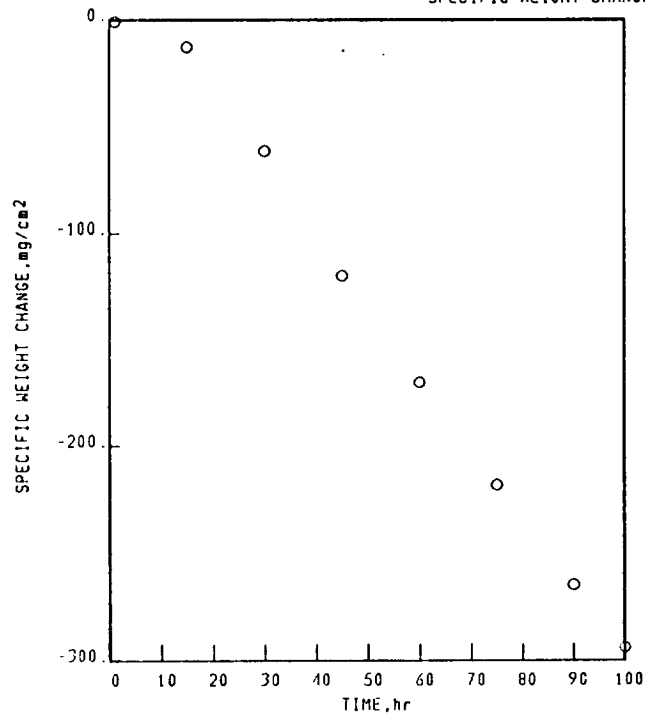
Ni BASE
UDINET-710

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-023-321-5

1150°C 1.00hr CYCLES 100.00hr TEST 2.329mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	-0.99
15.00	-12.97
30.00	-61.94
45.00	-120.03
60.00	-170.19
75.00	-218.44
90.00	-264.68
100.00	-294.07

Ni BASE
UDINET-710

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-023-321-5

1150°C 1.00hr CYCLES 100.00hr TEST 2.329mm THICK STATIC AIR

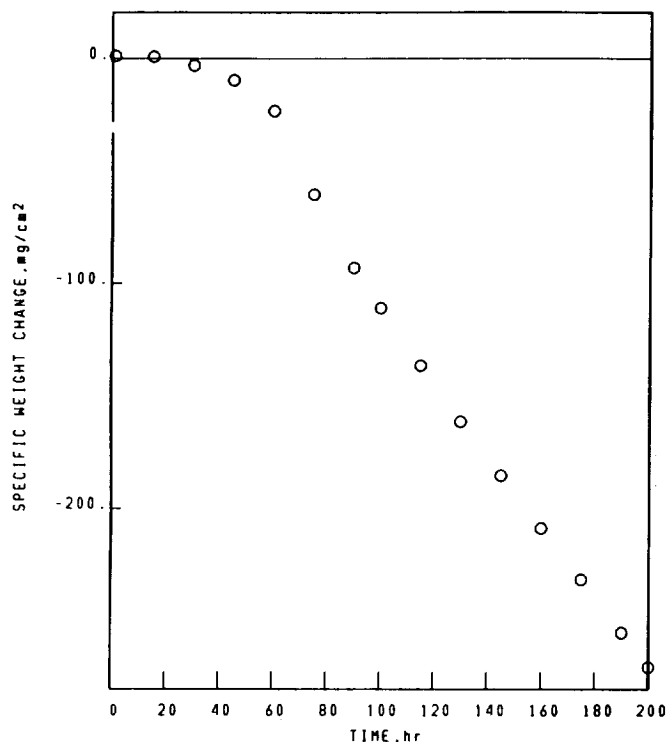
X-RAY DIFFRACTION DATA

SURFACE
100 hr
STANDARD SURFACE
SPINEL, $a_0=8.30\text{\AA}$.
NiO
Cr₂O₃
NiTiO₃
TRI(RUTILE), $d(110)\leq 3.30\text{\AA}$.
FACE CENTERED CUBIC MATRIX

SPALL
100 hr
COLLECTED SPALL
NiO
SPINEL, $a_0=8.25\text{\AA}$.
Ni(W,Mo)O₄ TYPE 2
Cr₂O₃

02-04-023-324-5

STATIC AIR



TIME, hr	$\Delta W/A, \text{mg/cm}^2$
0.00	0.00
1.00	1.04
15.00	0.69
30.00	-3.13
45.00	-9.66
60.00	-23.09
75.00	-60.49
90.00	-93.21
100.00	-111.14
115.00	-136.29
130.00	-161.11
145.00	-185.11
160.00	-208.69
175.00	-231.76
190.00	-255.12
200.00	-270.20

02-04-023-324-5

STATIC AIR

SURFACE
200 hr
STANDARD SURFACE
SPINEL, $a_0 = 8.30 \text{ \AA}$.
 NiO
 Cr_2O_3
 $\text{Ni}(\text{W},\text{Mo})\text{O}_4$ TYPE 2
 $\text{TR}(\text{RUTILE}), d(110) \leq 3.30 \text{ \AA}$.

FACE CENTERED CUBIC MATRIX

SPALL
200 hr
COLLECTED SPALL
NiO
SPINEL, $a_0 = 8.30 \text{ \AA}$.
 Cr_2O_3
 $(\text{Ni}, \text{Co}, \text{Fe})\text{TiO}_3$

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

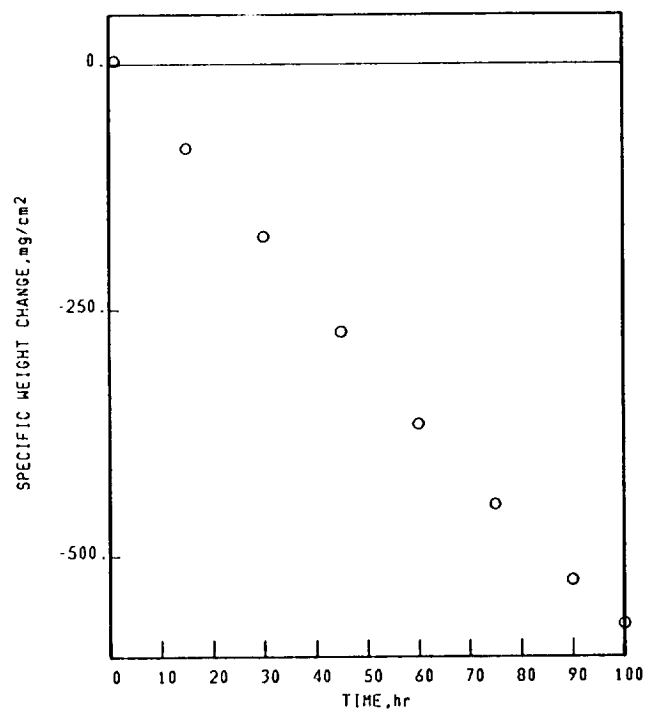
02-04-024-102-4

HAZ-20

1150°C 1.00hr CYCLES 100.00hr TEST 2.725mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	3.36
15.00	-85.34
30.00	-175.66
45.00	-272.21
60.00	-364.84
75.00	-447.27
90.00	-524.02
100.00	-568.27

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-024-102-5

HAZ-20

1150°C

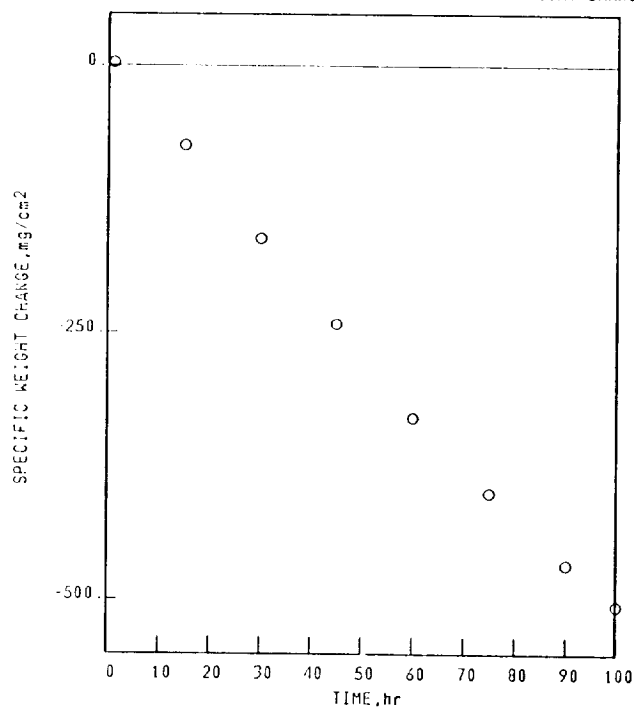
1.00hr CYCLES

100.00hr TEST

2.705mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	2.76
15.00	-74.59
30.00	-160.94
45.00	-241.34
60.00	-329.45
75.00	-398.74
90.00	-465.65
100.00	-505.33

NI BASE

COMMERCIAL CAST GAMMA/GAMMA PRIME ALLOYS

02-04-024-102-5

HAZ-20

1150°C

1.00hr CYCLES

100.00hr TEST

2.705mm THICK

STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

100 hr

STANDARD SURFACE

Ni(W,Mo)O₄ TYPE 1

SPALL

100 hr

COLLECTED SPALL

Ni(W,Mo)O₄ TYPE 1

Cr₂O₃

UNKNOWN LINES, d VALUES

3.80Å.

1.54Å.

1.00Å.

1.36Å.

Co BASE

CAST (TURBINE) ALLOYS

03-02-003-102-1

MAR-M-509

1150°C

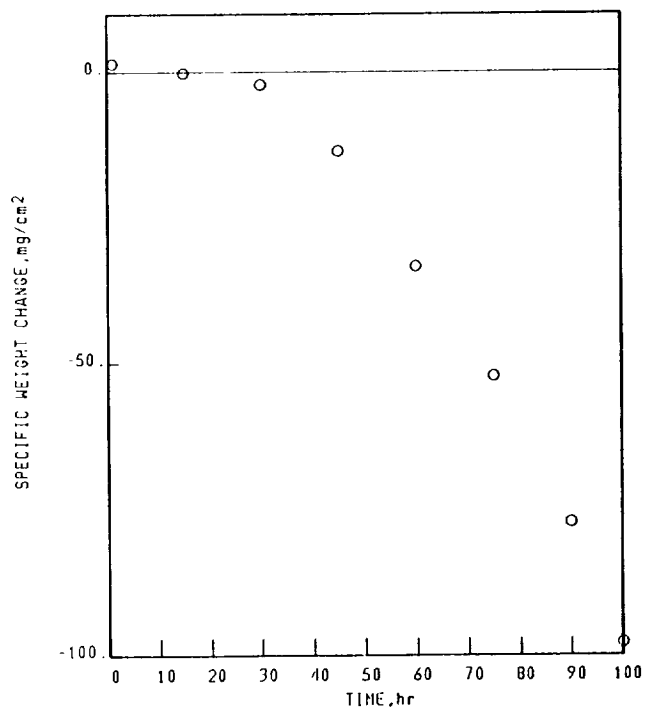
1.00hr CYCLES

100.00hr TEST

2.515mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	$\Delta W/A, \text{mg/cm}^2$
0.00	0.00
1.00	1.45
15.00	-0.16
30.00	-2.13
45.00	-13.60
60.00	-33.61
75.00	-52.28
90.00	-77.50
100.00	-97.87

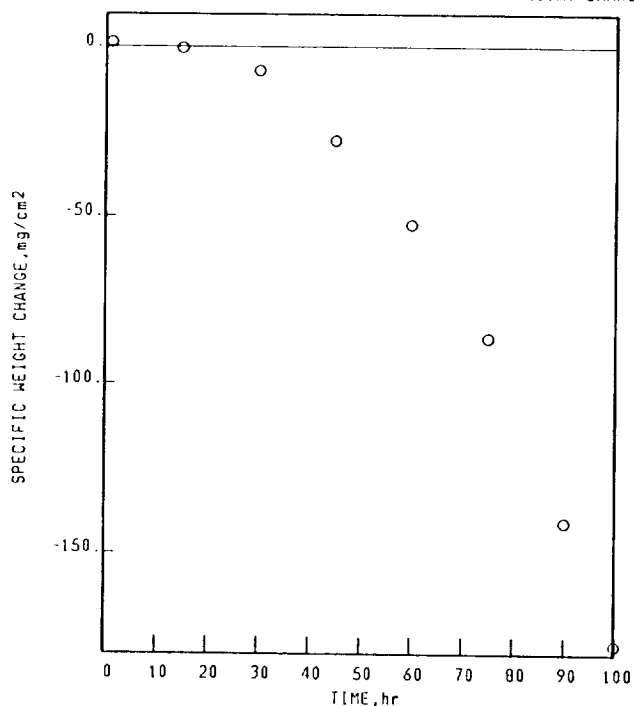
Co BASE
MAR-M-509

CAST (TURBINE) ALLOYS

03-02-003-102-2

1150°C 1.00hr CYCLES 100.00hr TEST 2.523mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	1.27
15.00	-0.40
30.00	-7.22
45.00	-27.82
60.00	-52.49
75.00	-86.38
90.00	-140.68
100.00	-177.51

Co BASE
MAR-M-509

CAST (TURBINE) ALLOYS

03-02-003-102-2

1150°C 1.00hr CYCLES 100.00hr TEST 2.523mm THICK STATIC AIR

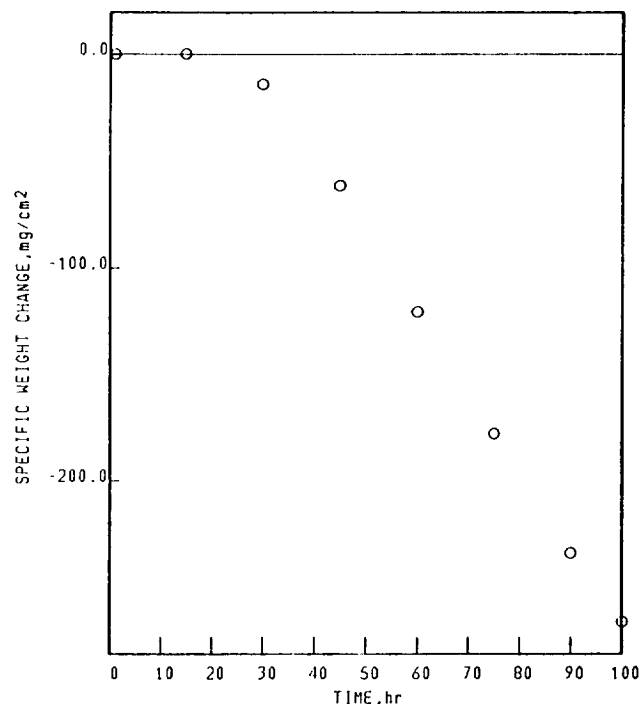
X-RAY DIFFRACTION DATA

SURFACE
100 hr
STANDARD SURFACE
Cr₂O₃
SPINEL, a₀=8.35Å.

SPALL
100 hr
COLLECTED SPALL
CoO
SPINEL, a₀=8.25Å.
Cr₂O₃

Co BASE CAST (TURBINE) ALLOYS 03-02-003-323-4
 MAR-M-509 1150°C 1.00hr CYCLES 100.00hr TEST 2.338mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	$\Delta W/A, \text{mg/cm}^2$
0.00	0.00
1.00	-0.10
15.00	0.10
30.00	-14.11
45.00	-61.87
60.00	-120.62
75.00	-177.90
90.00	-233.02
100.00	-265.19

Co BASE CAST (TURBINE) ALLOYS 03-02-003-323-4
 MAR-M-509 1150°C 1.00hr CYCLES 100.00hr TEST 2.338mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE	SPALL
100 hr	100 hr
STANDARD SURFACE	COLLECTED SPALL
SPINEL, $a_0=8.30\text{\AA}$.	CoO
CoO	SPINEL, $a_0=8.30\text{\AA}$.
Cr ₂ O ₃	Ni(W,Mo)O ₄ TYPE 1
FACE CENTERED CUBIC MATRIX	

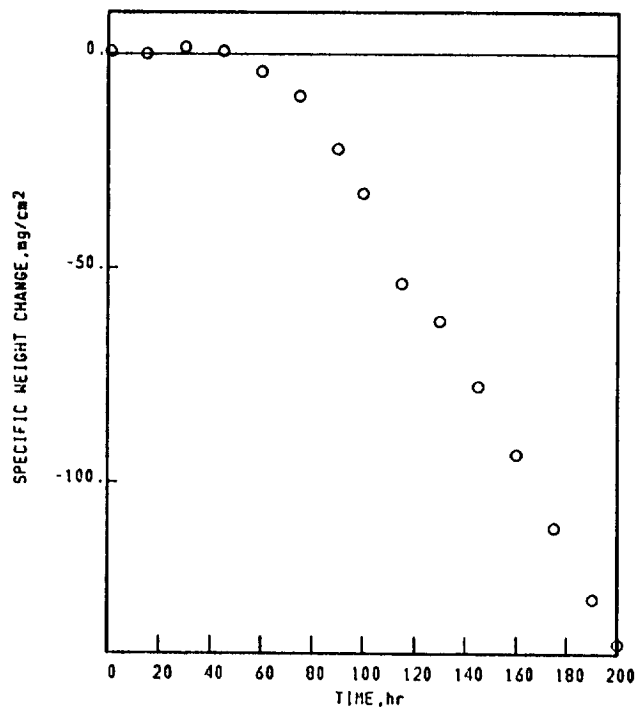
Co BASE
MAR-M-509

CAST (TURBINE) ALLOYS

03-02-003-310-1

1100°C 1.00hr CYCLES 200.00hr TEST 2.330mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.62
15.00	0.06
30.00	1.61
45.00	0.68
60.00	-4.03
75.00	-9.61
90.00	-21.89
100.00	-32.34
115.00	-53.60
130.00	-62.38
145.00	-77.45
160.00	-93.43
175.00	-110.65
190.00	-127.44
200.00	-137.90

Co BASE
MAR-M-509

CAST (TURBINE) ALLOYS

03-02-003-310-1

1100°C 1.00hr CYCLES 200.00hr TEST 2.330mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE
200 hr
STANDARD SURFACE
SPINEL, $a_0=8.35\text{\AA}$.
CoO

SPALL
200 hr
COLLECTED SPALL
SPINEL, $a_0=8.35\text{\AA}$.
CoO
 Al_2TiO_5

Co BASE

CAST (TURBINE) ALLOYS

03-02-003-326-4

MAR-M-509

1100°C

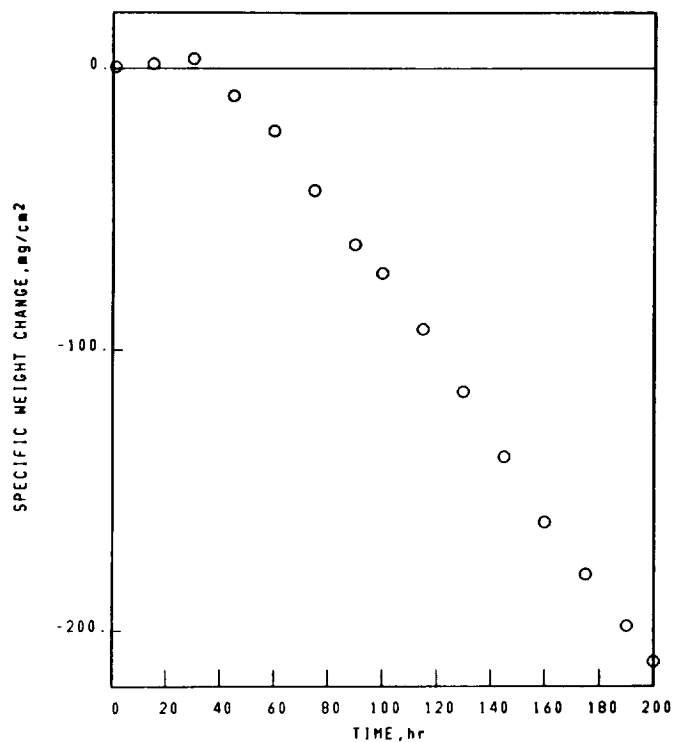
1.00hr CYCLES

200.00hr TEST

2.327mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.56
15.00	1.64
30.00	3.52
45.00	-9.71
60.00	-22.28
75.00	-43.42
90.00	-62.52
100.00	-72.71
115.00	-92.81
130.00	-115.17
145.00	-138.43
160.00	-161.24
175.00	-179.81
190.00	-198.26
200.00	-211.15

Co BASE

CAST (TURBINE) ALLOYS

03-02-003-326-4

MAR-M-509

1100°C

1.00hr CYCLES

200.00hr TEST

2.327mm THICK

STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

200 hr

STANDARD SURFACE

CoO

SPINEL, $a_0=8.35\text{\AA}$. Al_2TiO_5

FACE CENTERED CUBIC MATRIX

SPALL

200 hr

COLLECTED SPALL

SPINEL, $a_0=8.35\text{\AA}$.

CoO

 Al_2TiO_5

Co BASE

CAST (TURBINE) ALLOYS

03-02-002-099-1

HI-52

1150°C

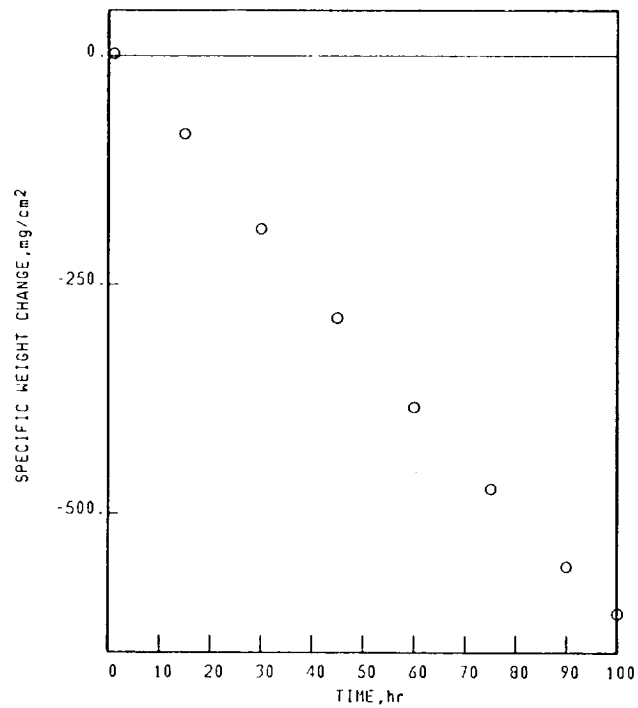
1.00hr CYCLES

100.00hr TEST

2.720mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	2.49
15.00	-85.39
30.00	-189.58
45.00	-286.05
60.00	-383.38
75.00	-472.69
90.00	-557.34
100.00	-608.21

Co BASE

CAST (TURBINE) ALLOYS

03-02-002-099-2

WI-52

1150°C

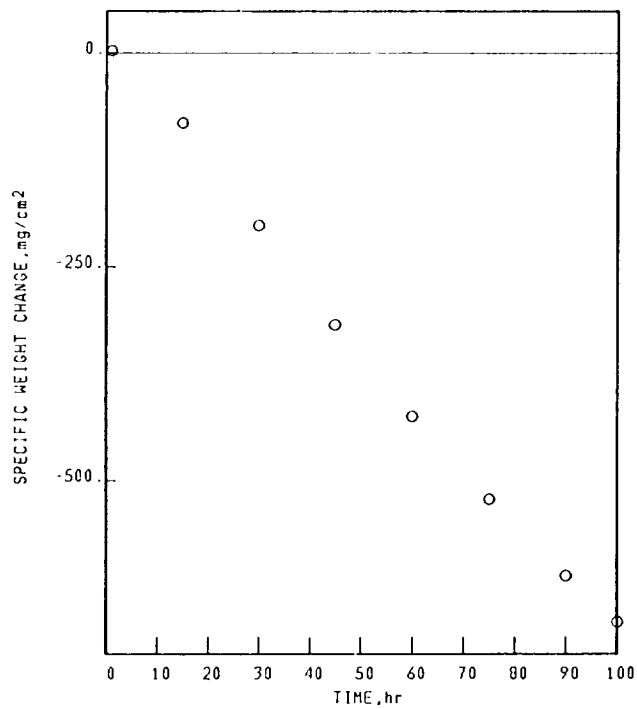
1.00hr CYCLES

100.00hr TEST

2.694mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	$\Delta W/A, \text{mg/cm}^2$
0.00	0.00
1.00	2.65
15.00	-81.87
30.00	-202.28
45.00	-317.06
60.00	-424.07
75.00	-521.30
90.00	-609.22
100.00	-663.28

Co BASE

CAST (TURBINE) ALLOYS

03-02-002-099-2

WI-52

1150°C

1.00hr CYCLES

100.00hr TEST

2.694mm THICK

STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

100 hr

STANDARD SURFACE

SPINEL, $a_0=0.35\text{\AA}$. Cr_2O_3 CoWO_4 15-867

SPALL

100 hr

COLLECTED SPALL

CoO

SPINEL, $a_0=0.35\text{\AA}$. CoWO_4 15-867

FACE CENTERED CUBIC MATRIX

Co BASE

CAST (TURBINE) ALLOYS

03-02-002-105-4

W1 52

1150°C

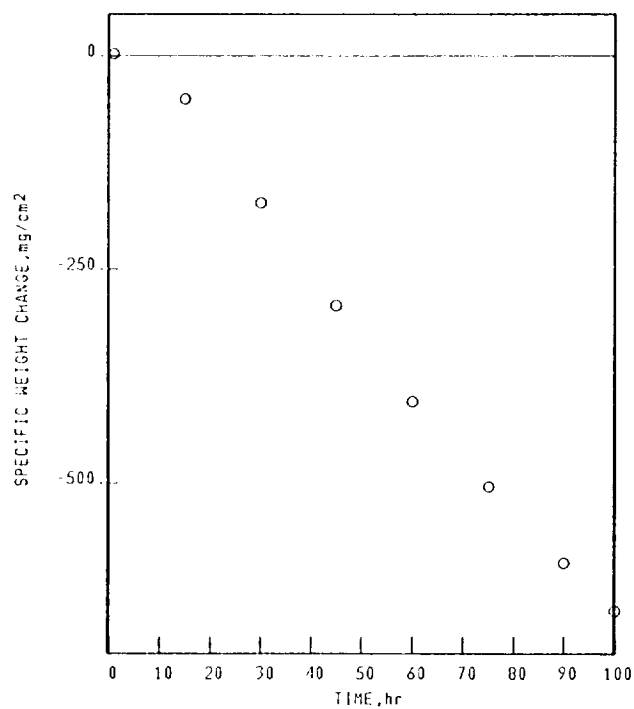
1.00hr CYCLES

100.00hr TEST

2.651mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	2.25
15.00	-49.38
30.00	-171.39
45.00	-292.62
60.00	-403.98
75.00	-503.75
90.00	-594.00
100.00	-650.60

Co BASE

CAST (TURBINE) ALLOYS

03-02-002-105-5

WI-52

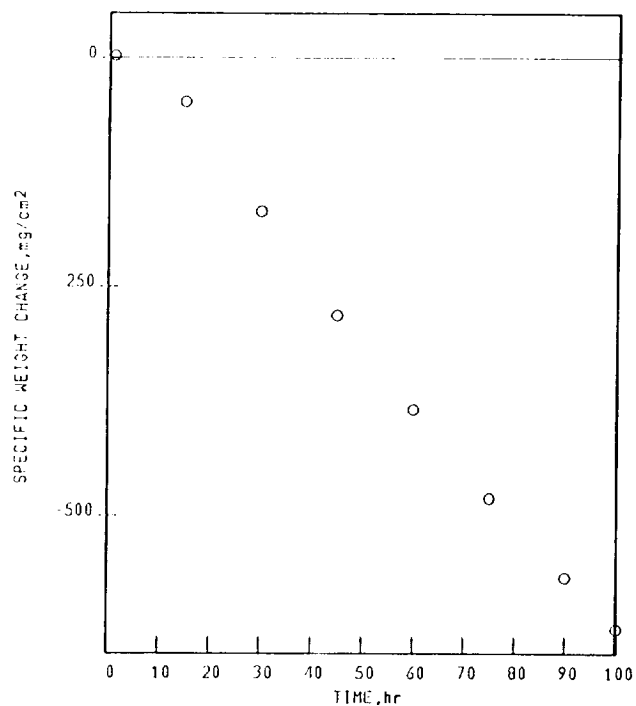
1150°C

1.00hr CYCLES

100.00hr TEST 2.657mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	$\Delta W/A, \text{mg/cm}^2$
0.00	0.00
1.00	2.28
15.00	-48.40
30.00	-167.99
45.00	-281.23
60.00	-385.22
75.00	-481.24
90.00	-567.32
100.00	-623.71

Co BASE

CAST (TURBINE) ALLOYS

03-02-002-105-5

WI-52

1150°C

1.00hr CYCLES

100.00hr TEST 2.657mm THICK

STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

100 hr

STANDARD SURFACE

SPINEL, $a_0 = 8.35\text{\AA}$. Cr_2O_3

NiO

SPALL

100 hr

COLLECTED SPALL

CoO

SPINEL, $a_0 = 8.20\text{\AA}$.SPINEL, $a_0 = 8.30\text{\AA}$. Al_2O_3

Co BASE

CAST (TURBINE) ALLOYS

03-02-002-120-5

W1-52

1150°C

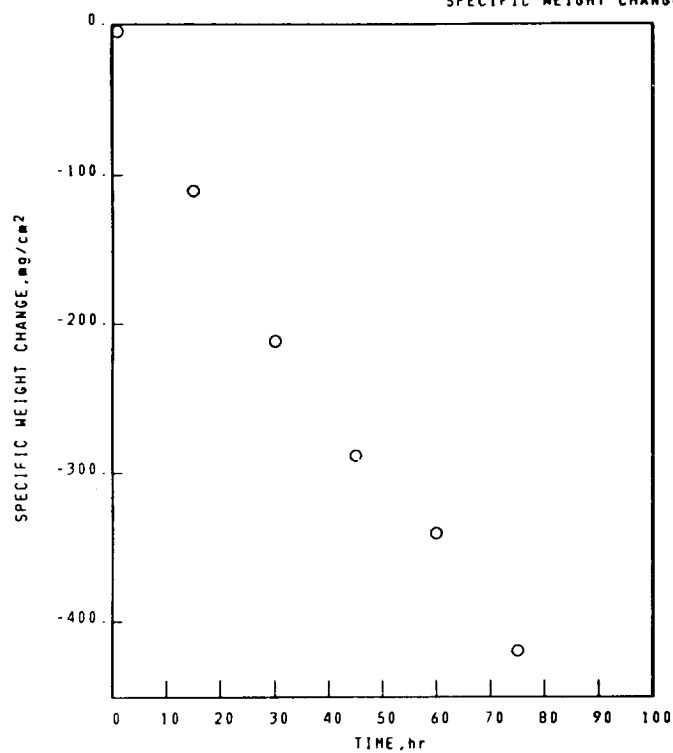
1.00hr CYCLES

75.00hr TEST

3.226mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	-4.82
15.00	-110.82
30.00	-211.43
45.00	-288.20
60.00	-340.42
75.00	-418.96

Co BASE

CAST (TURBINE) ALLOYS

03-02-002-120-1

W.-52

1093°C

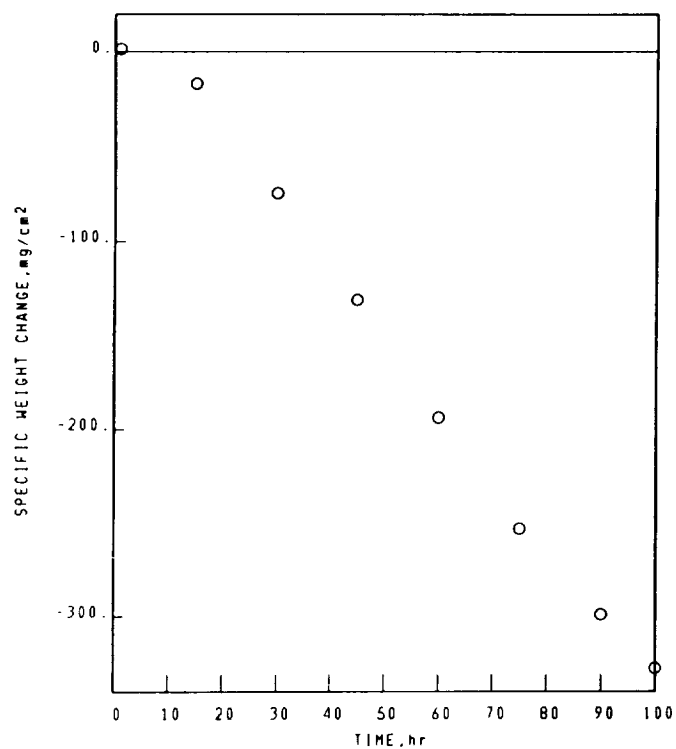
1.00hr CYCLES

100.00hr TEST

3.226mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	$\Delta W/A, \text{mg/cm}^2$
0.00	0.00
1.00	1.45
15.00	-16.88
30.00	-74.28
45.00	-131.47
60.00	-194.07
75.00	-253.06
90.00	-298.92
100.00	-327.52

Co BASE

CAST (TURBINE) ALLOYS

03-02-002-120-2

W1-52

1093°C

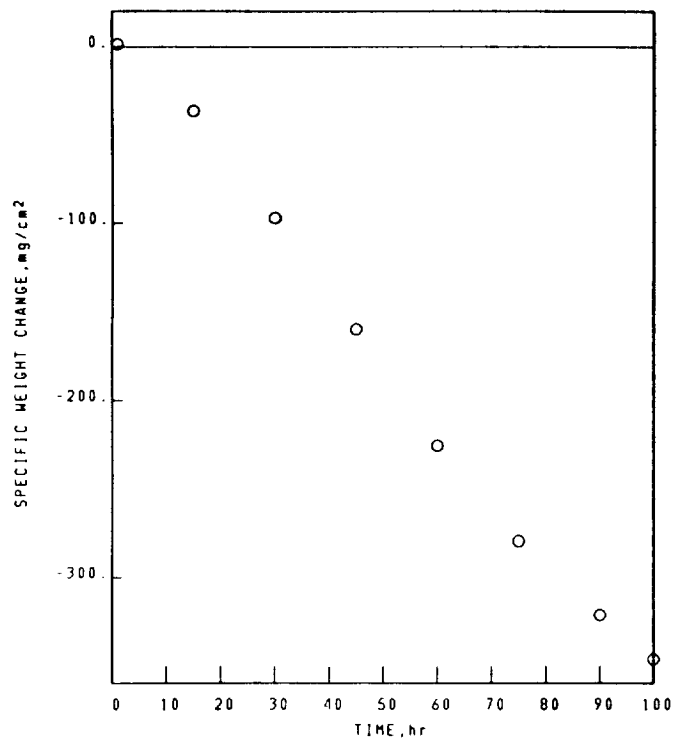
1.00hr CYCLES

100.00hr TEST

3.226mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	1.42
15.00	-36.47
30.00	-97.13
45.00	-159.57
60.00	-225.73
75.00	-279.36
90.00	-320.91
100.00	-346.38

Co BASE

CAST (TURBINE) ALLOYS

03-02-002-120-2

W1-52

1093°C

1.00hr CYCLES

100.00hr TEST

3.226mm THICK

STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

100 hr

STANDARD SURFACE

Cr₂O₃CoWO₄ 15-867

CoO

SPINEL, a₀=8.35Å.

TRI(RUTILE), d(110)>3.30Å.

SPALL

100 hr

COLLECTED SPALL

CoO

SPINEL, a₀=8.30Å.CoWO₄ 15-867

Co BASE

CAST (TURBINE) ALLOYS

03-02-002-151-1

WI-52

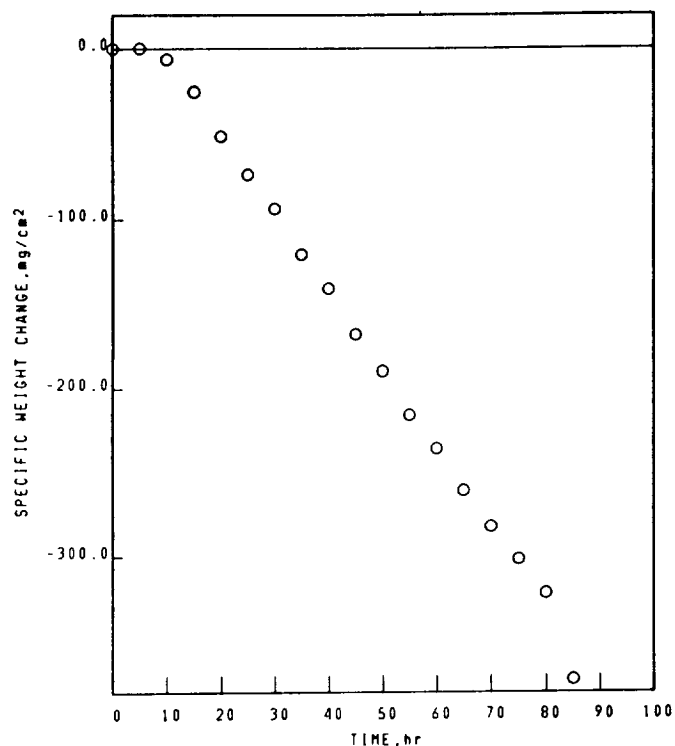
1093°C

0.05hr CYCLES

85.00hr TEST 3.226mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	$\Delta W/A, \text{mg/cm}^2$
0.00	0.00
0.05	0.07
5.00	0.28
10.00	-6.07
15.00	-24.80
20.00	-51.01
25.00	-73.54
30.00	-93.90
35.00	-121.18
40.00	-141.62
45.00	-168.72
50.00	-190.32
55.00	-216.15
60.00	-235.91
65.00	-260.99
70.00	-282.52
75.00	-301.78
80.00	-321.90
85.00	-372.34

Co BASE

CAST (TURBINE) ALLOYS

03-02-002-151-1

WI-52

1093°C

0.05hr CYCLES

85.00hr TEST 3.226mm THICK

STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

100 hr

STANDARD SURFACE

CoO

SPINEL, $a_0=8.30\text{\AA}$.Cr₂O₃

FACE CENTERED CUBIC MATRIX

SPALL

100 hr

COLLECTED SPALL

CoO

SPINEL, $a_0=8.30\text{\AA}$.

Co BASE

CAST (TURBINE) ALLOYS

03-02-002-151-2

MI-52

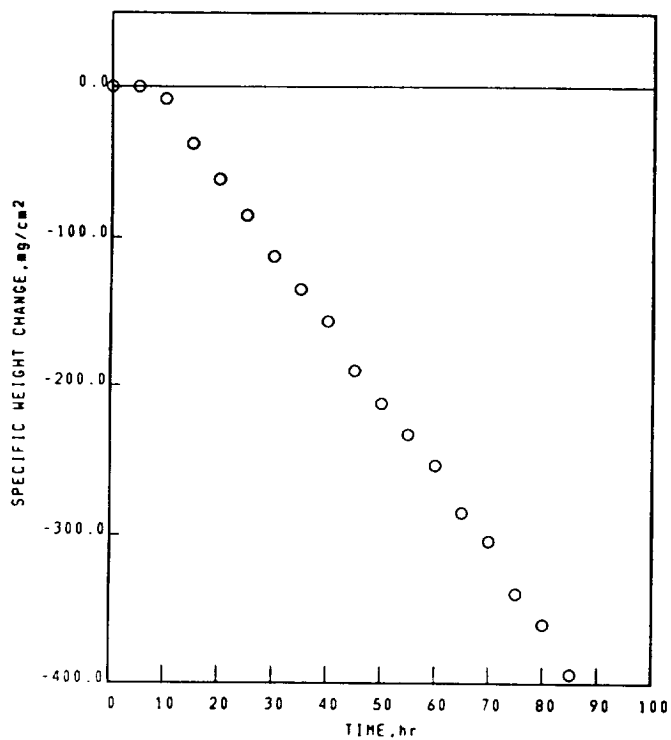
1093°C

0.05hr CYCLES

85.00hr TEST 3.277mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
0.05	0.07
5.00	0.18
10.00	-8.08
15.00	-37.93
20.00	-61.72
25.00	-85.37
30.00	-112.80
35.00	-134.93
40.00	-156.48
45.00	-190.09
50.00	-212.17
55.00	-232.95
60.00	-253.47
65.00	-284.71
70.00	-303.60
75.00	-339.34
80.00	-360.25
85.00	-393.72

Co BASE

CAST (TURBINE) ALLOYS

03-02-002-140-4

W1-52

1038°C

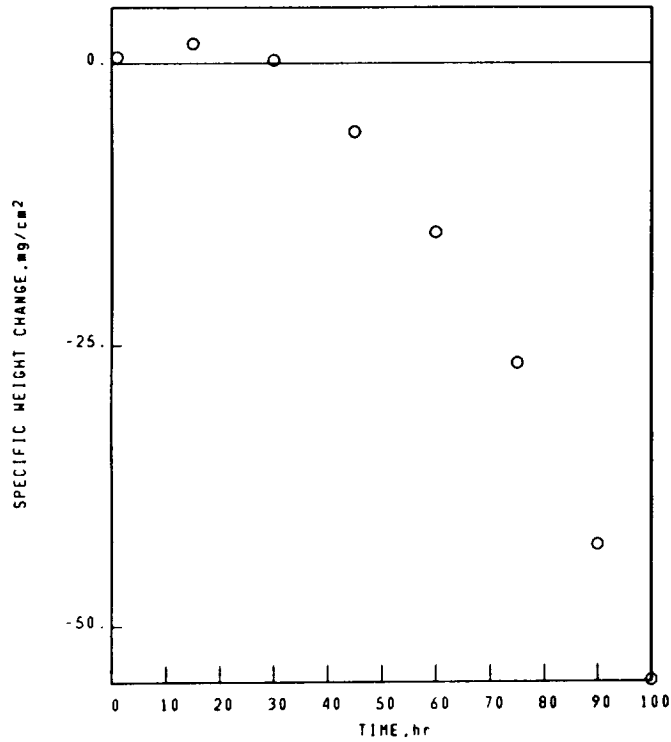
1.00hr CYCLES

100.00hr TEST

3.251mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.57
15.00	1.77
30.00	0.28
45.00	-6.04
60.00	-14.91
75.00	-26.64
90.00	-42.72
100.00	-54.87

Co BASE

CAST (TURBINE) ALLOYS

03-02-002-140-4

W1-52

1038°C

1.00hr CYCLES

100.00hr TEST

3.251mm THICK

STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

100 hr

STANDARD SURFACE

SPINEL, $\theta_0 = 8.30^\circ$ Cr_2O_3

CoO

SPALL

100 hr

COLLECTED SPALL

SPINEL, $\theta_0 = 8.30^\circ$ SPINEL, $\theta_0 = 8.40^\circ$ UNKNOWN LINES, d VALUES

1.76Å.

Co BASE

CAST (TURBINE) ALLOYS

03-02-002-140-5

MI-52

1038°C

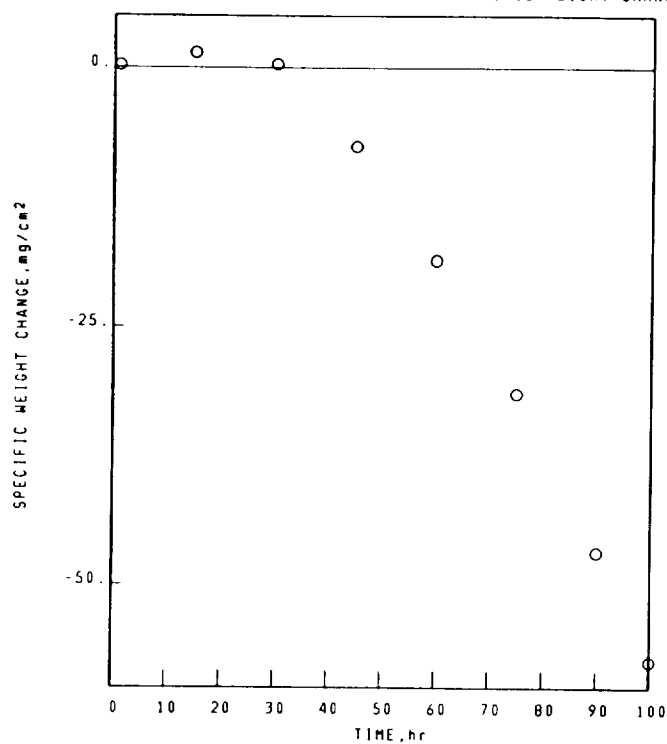
1.00hr CYCLES

100.00hr TEST

3.226mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	$\Delta W/A, \text{mg/cm}^2$
0.00	0.00
1.00	0.21
15.00	1.43
30.00	0.32
45.00	-7.66
60.00	-18.57
75.00	-31.48
90.00	-46.77
100.00	-57.43

Co BASE

CAST (TURBINE) ALLOYS

03-02-002-104-1

HI-52

982°C

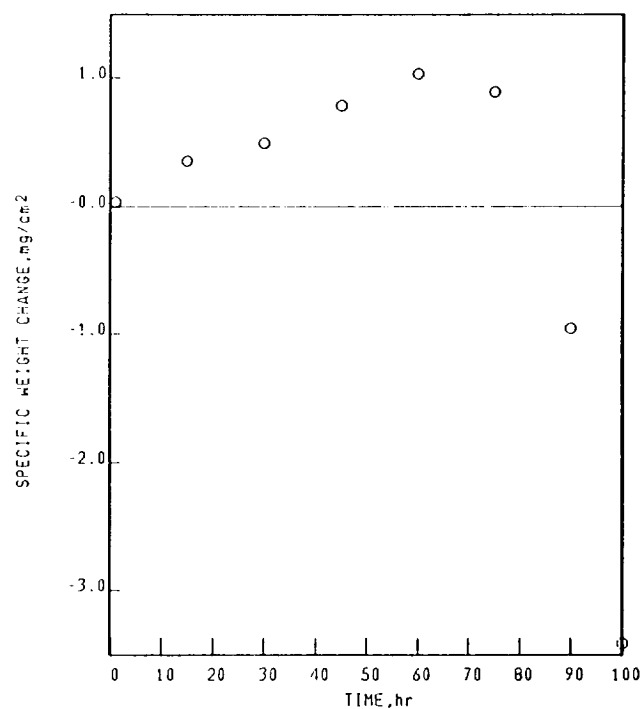
1.00hr CYCLES

100.00hr TEST

3.226mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.04
15.00	0.36
30.00	0.50
45.00	0.78
60.00	1.03
75.00	0.89
90.00	-0.96
100.00	-3.41

Co BASE

CAST (TURBINE) ALLOYS

03-02-002-104-1

HI-52

982°C

1.00hr CYCLES

100.00hr TEST

3.226mm THICK

STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

100 hr

STANDARD SURFACE

SPINEL, $a_0 = 8.30 \text{ \AA}$.Cr₂O₃

CoO

SPALL

100 hr

COLLECTED SPALL

CoO

SPINEL, $a_0 = 8.30 \text{ \AA}$.

Co BASE

CAST (TURBINE) ALLOYS

03-02-002-104-2

WI-52

982°C

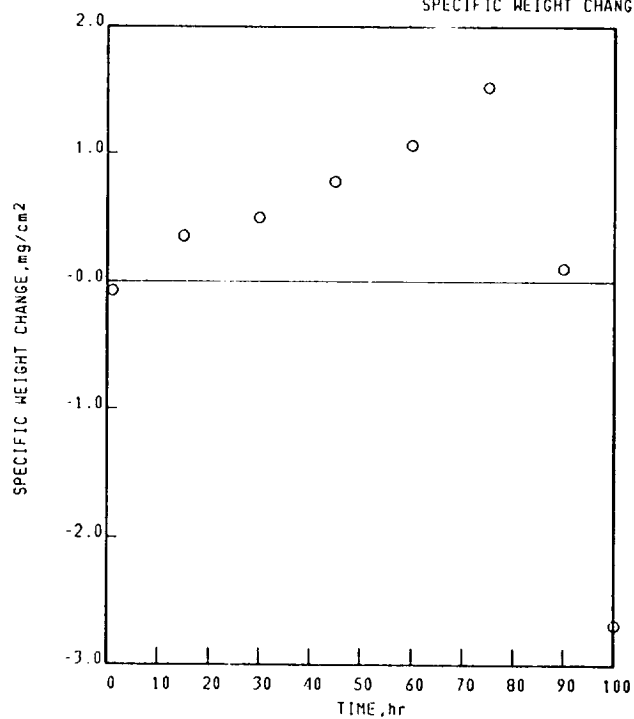
1.00hr CYCLES

100.00hr TEST

3.251mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	$\Delta W/A, \text{mg/cm}^2$
0.00	0.00
1.00	-0.07
15.00	0.35
30.00	0.49
45.00	0.78
60.00	1.06
75.00	1.52
90.00	0.11
100.00	-2.69

Co BASE

CAST (TURBINE) ALLOYS

03-02-001-095-5

X-40

1150°C

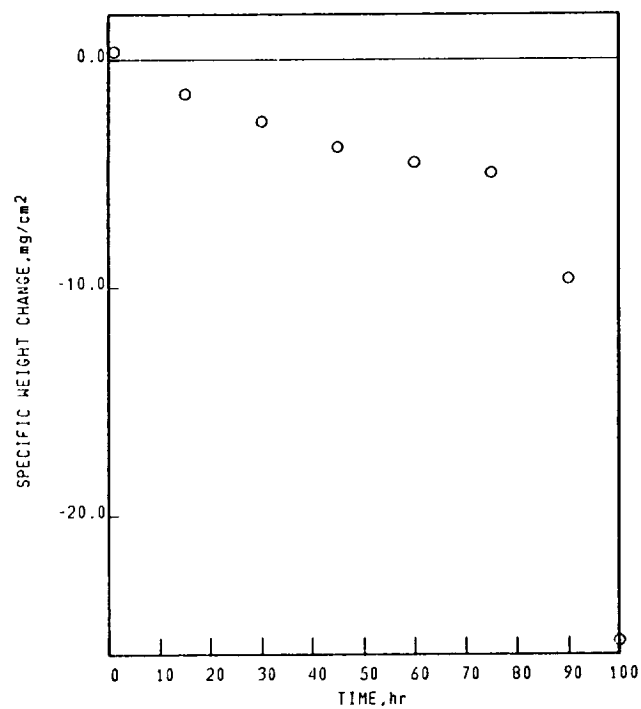
1.00hr CYCLES

100.00hr TEST

3.258mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.35
15.00	-1.48
30.00	-2.69
45.00	-3.82
60.00	-4.49
75.00	-4.95
90.00	-9.65
100.00	-25.44

Co BASE

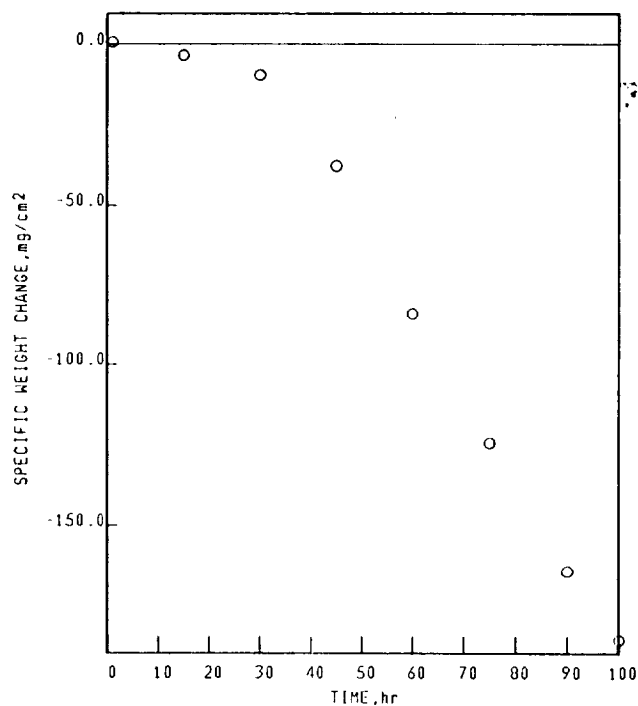
CAST (TURBINE) ALLOYS

03-02-001-095-4

X-40

1150°C 1.00hr CYCLES 100.00hr TEST 3.270mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.63
15.00	-3.41
30.00	-9.64
45.00	-37.83
60.00	-84.11
75.00	-124.40
90.00	-164.27
100.00	-185.95

Co BASE

CAST (TURBINE) ALLOYS

03-02-001-095-4

X-40

1150°C 1.00hr CYCLES 100.00hr TEST 3.270mm THICK STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE
100 hr
STANDARD SURFACE
SPINEL, $a_0 = 8.25\text{\AA}$.
 Cr_2O_3

SPALL
100 hr
COLLECTED SPALL
CoO
SPINEL, $a_0 = 8.25\text{\AA}$.
SPINEL, $a_0 = 8.20\text{\AA}$.
 Cr_2O_3

Co BASE

CAST (TURBINE) ALLOYS

03-02-001-105-3

X-40

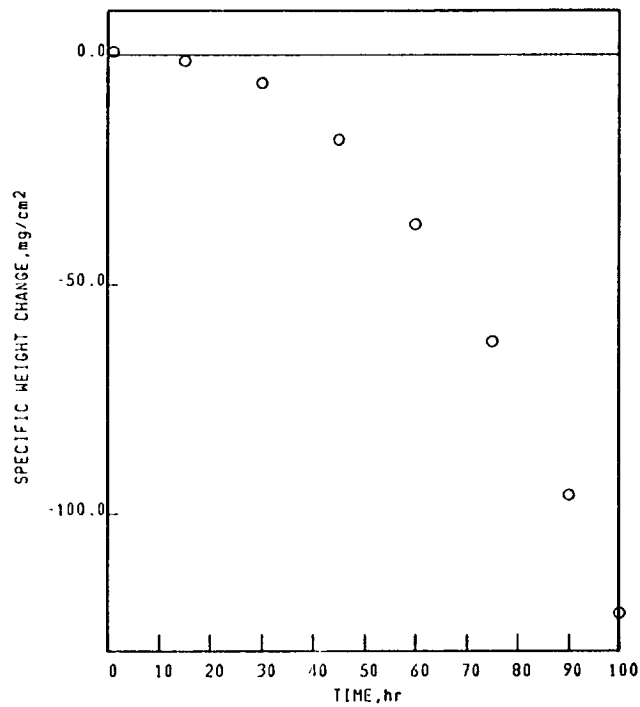
1150°C

1.00hr CYCLES

100.00hr TEST 2.521mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔH/A, mg/cm²
0.00	0.00
1.00	0.75
15.00	-1.32
30.00	-6.12
45.00	-18.47
60.00	-36.83
75.00	-62.61
90.00	-95.96
100.00	-121.83

Co BASE

CAST (TURBINE) ALLOYS

03-02-001-105-3

X-40

1150°C

1.00hr CYCLES

100.00hr TEST 2.521mm THICK

STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE
100 hr
STANDARD SURFACE
SPINEL, $a_0 = 8.35 \text{ \AA}$.
 Cr_2O_3
 NiO
 $\text{Ni}(\text{W}, \text{Mo})\text{O}_4$ TYPE 1

SPALL
100 hr
COLLECTED SPALL
 CoO

Co BASE

CAST (TURBINE) ALLOYS

03-02-001-105-6

X-40

1150°C

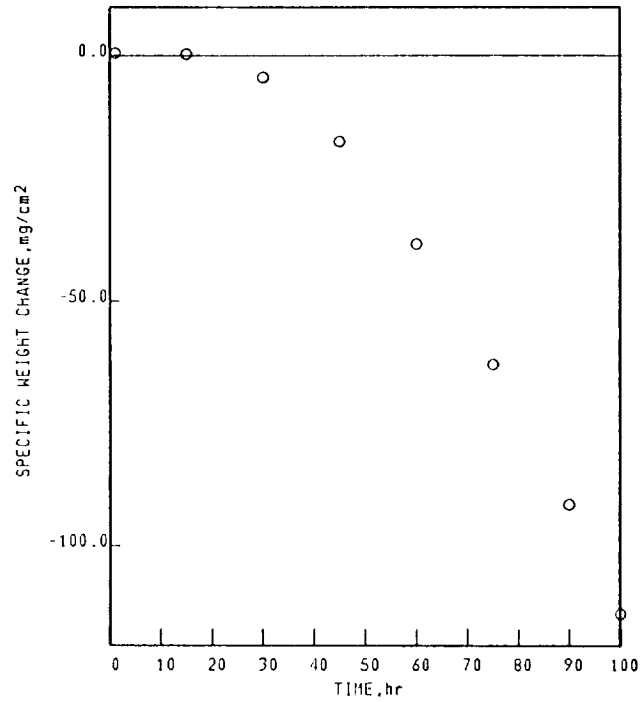
1.00hr CYCLES

100.00hr TEST

2.568mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.55
15.00	0.35
30.00	-4.43
45.00	-17.62
60.00	-38.52
75.00	-62.81
90.00	-91.53
100.00	-113.63

Co BASE

CAST (TURBINE) ALLOYS

03-02-001-128-3

X-40

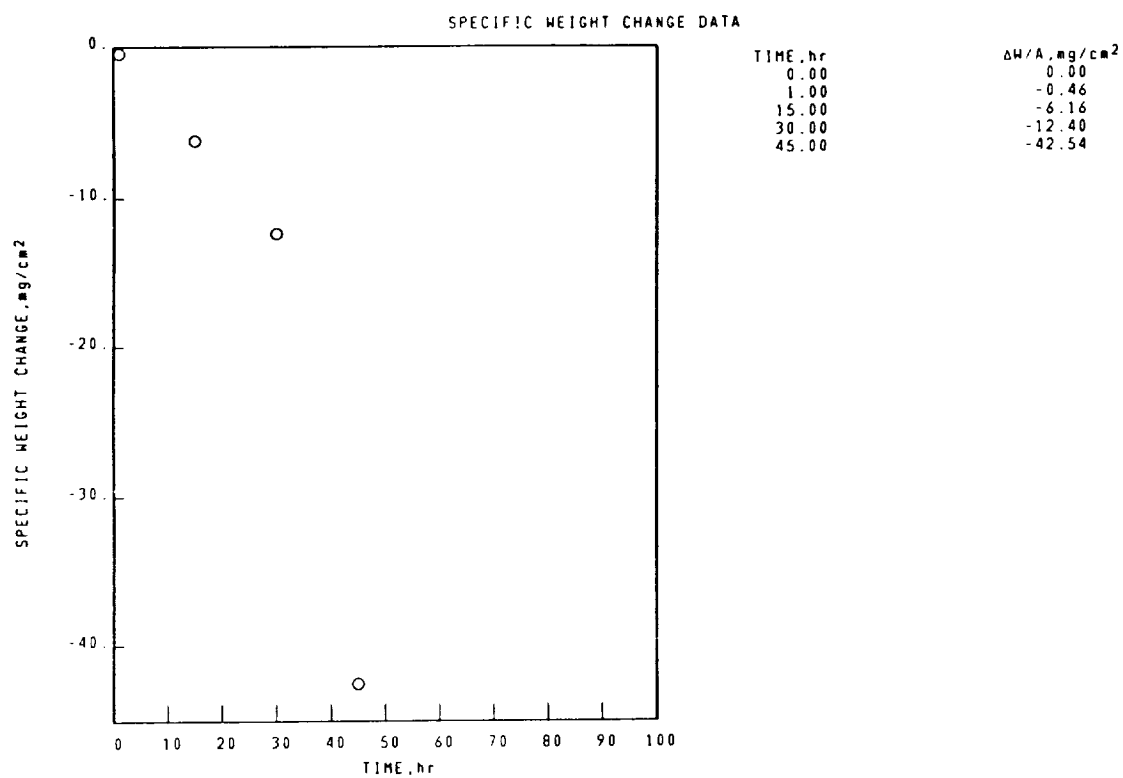
1150°C

1.00hr CYCLES

45.00hr TEST

3.251mm THICK

STATIC AIR



Co BASE

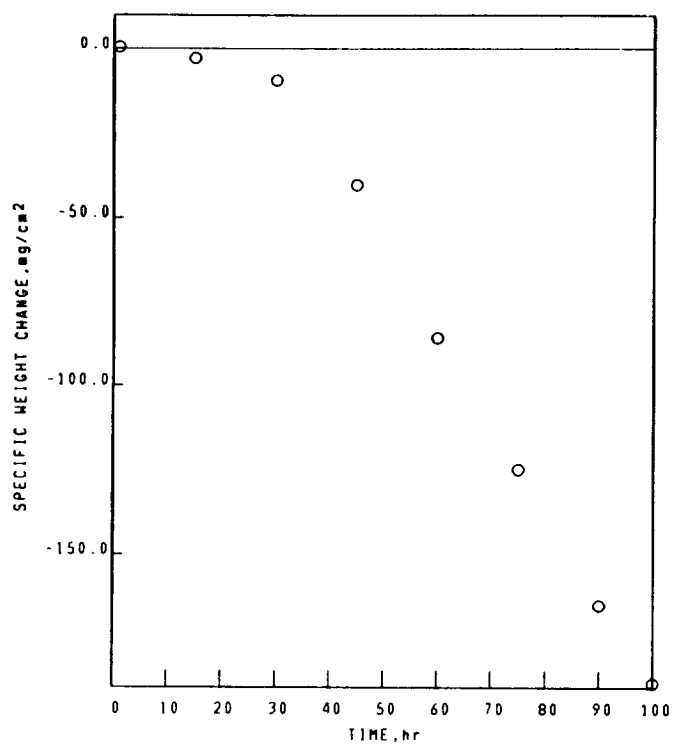
CAST (TURBINE) ALLOYS

03-02-001-128-6

X-40

1150°C 1.00hr CYCLES 100.00hr TEST 3.150mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	$\Delta W/A, \text{mg/cm}^2$
0.00	0.00
1.00	0.43
15.00	-2.87
30.00	-9.48
45.00	-40.58
60.00	-85.83
75.00	-125.04
90.00	-165.30
100.00	-188.64

Co BASE

CAST (TURBINE) ALLOYS

03-02-001-146-3

X-40

1150°C

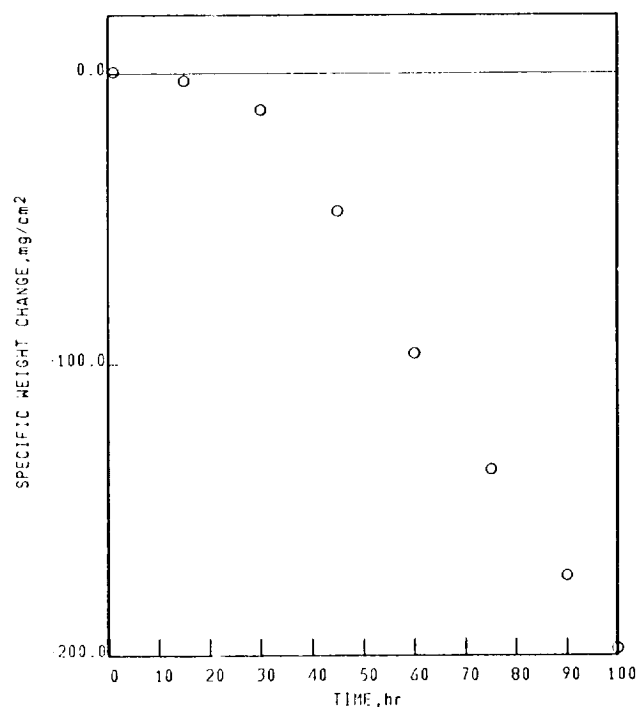
1.00hr CYCLES

100.00hr TEST

3.251mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.53
15.00	-2.47
30.00	-12.54
45.00	-47.66
60.00	-96.42
75.00	-136.53
90.00	-173.17
100.00	-197.87

Co BASE

CAST (TURBINE) ALLOYS

03-02-001-096-4

X-40

1093°C

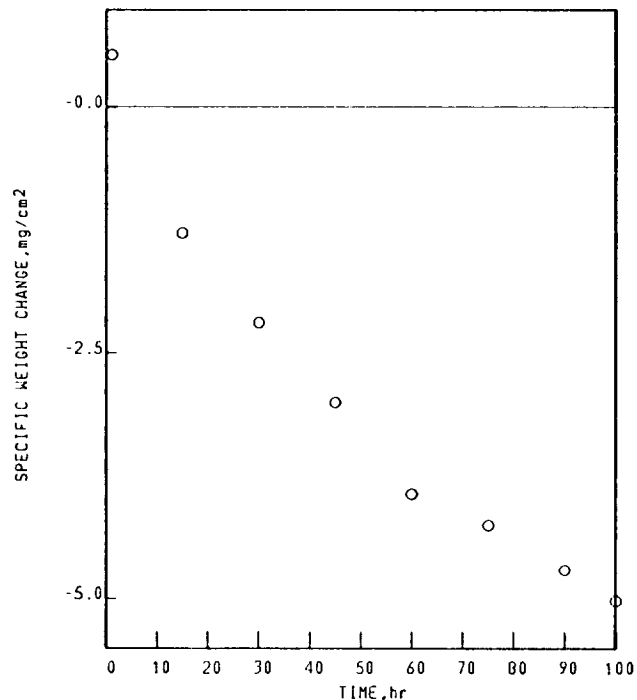
1.00hr CYCLES

100.00hr TEST

3.251mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.53
15.00	-1.27
30.00	-2.19
45.00	-3.00
60.00	-3.92
75.00	-4.24
90.00	-4.70
100.00	-5.02

Co BASE

CAST (TURBINE) ALLOYS

03-02-001-096-4

X-40

1093°C

1.00hr CYCLES

100.00hr TEST

3.251mm THICK

STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

100 hr

STANDARD SURFACE

SPINEL, $a_0=8.35\text{\AA}$.

SPALL

100 hr

COLLECTED SPALL

CoO

SPINEL, $a_0=8.35\text{\AA}$.

Cr₂O₃

Co BASE

CAST (TURBINE) ALLOYS

03-02-001-096-5

X-40

1093°C

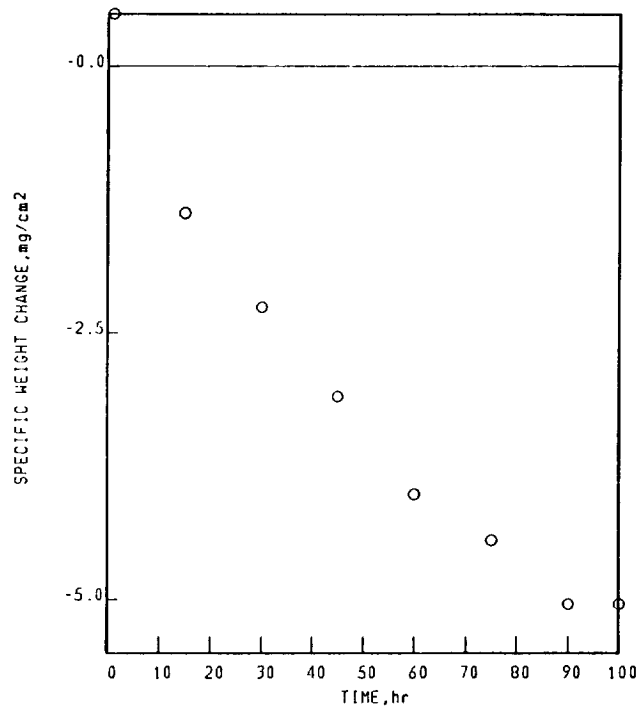
1.00hr CYCLES

100.00hr TEST

3.251mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.49
15.00	-1.37
30.00	-2.26
45.00	-3.10
60.00	-4.02
75.00	-4.44
90.00	-5.04
100.00	-5.04

Co BASE

CAST (TURBINE) ALLOYS

03-02-001-131-5

X-40

1093°C

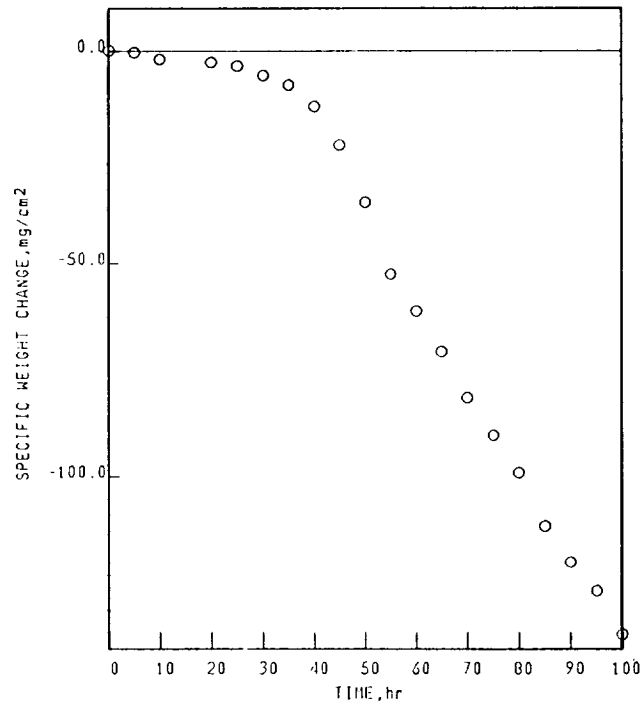
0.05hr CYCLES

100.00hr TEST

0.128mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
0.05	0.18
5.00	-0.28
10.00	-1.91
20.00	-2.65
25.00	-3.46
30.00	-5.72
35.00	-7.95
40.00	-12.93
45.00	-22.08
50.00	-35.62
55.00	-52.51
60.00	-61.16
65.00	-70.49
70.00	-81.27
75.00	-90.13
80.00	-99.00
85.00	-111.55
90.00	-119.96
95.00	-126.74
100.00	-136.70

Co BASE

CAST (TURBINE) ALLOYS

03-02-001-131-5

X-40

1093°C

0.05hr CYCLES

100.00hr TEST

0.128mm THICK

STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

100 hr

STANDARD SURFACE

CoO

SPINEL, $a_0=8.30\text{\AA}$.Cr₂O₃

SPALL

100 hr

SECOND SURFACE PHASE

SPINEL, $a_0=8.45\text{\AA}$.

CoO

Co BASE

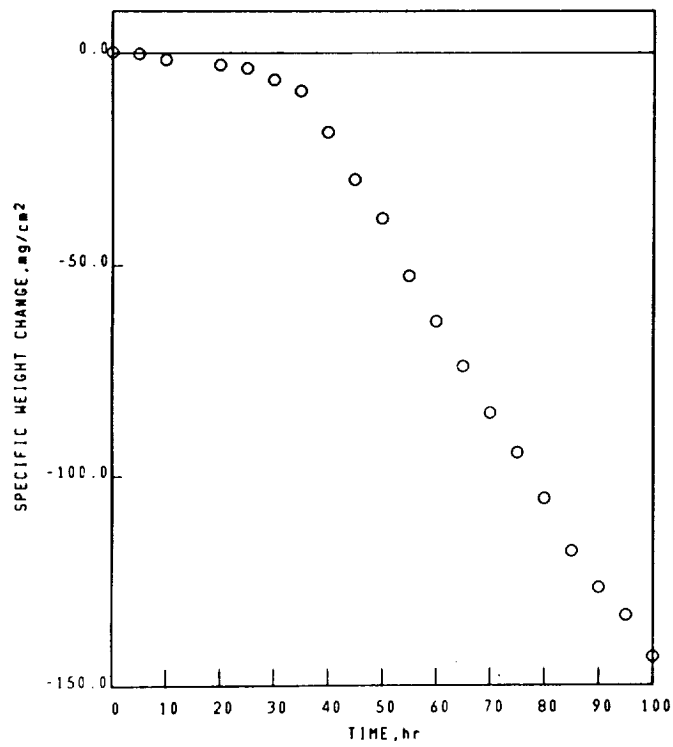
CAST (TURBINE) ALLOYS

03-02-001-131-4

X-40

1093°C 0.05hr CYCLES 100.00hr TEST 3.251mm THICK STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
0.05	0.21
5.00	-0.21
10.00	-1.59
20.00	-2.83
25.00	-3.64
30.00	-6.32
35.00	-9.01
40.00	-18.73
45.00	-29.75
50.00	-39.04
55.00	-52.68
60.00	-63.64
65.00	-74.31
70.00	-85.44
75.00	-94.62
80.00	-105.50
85.00	-117.98
90.00	-126.67
95.00	-133.35
100.00	-143.21

C0 BASE

CAST (TURBINE) ALLOYS

03-02-001-143-5

X-40

1093°C

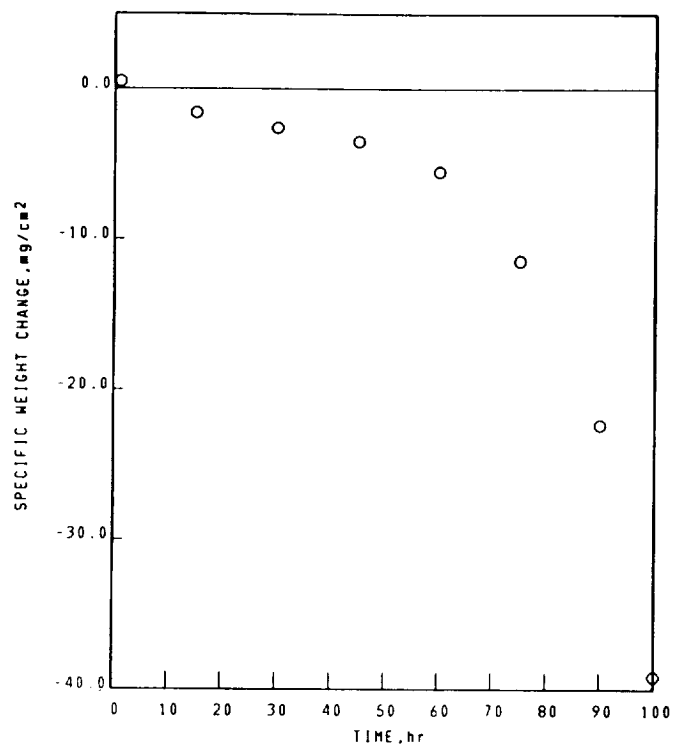
1.00hr CYCLES

100.00hr TEST

3.251mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	$\Delta W/A, \text{mg/cm}^2$
0.00	0.00
1.00	0.49
15.00	-1.59
30.00	-2.61
45.00	-3.53
60.00	-5.55
75.00	-11.41
90.00	-22.37
100.00	-39.15

Co BASE

CAST (TURBINE) ALLOYS

03-02-001-098-4

X-40

1038°C

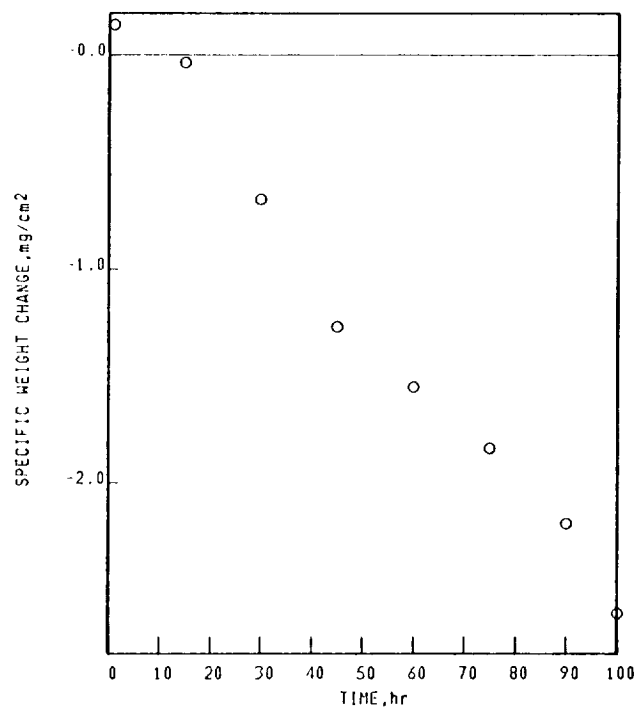
1.00hr CYCLES

100.00hr TEST

3.251mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME,hr	ΔW/A,mg/cm²
0.00	0.00
1.00	0.14
15.00	-0.04
30.00	-0.67
45.00	-1.27
60.00	-1.55
75.00	-1.84
90.00	-2.19
100.00	-2.61

Co BASE

CAST (TURBINE) ALLOYS

03-02-001-098-5

X-40

1038°C

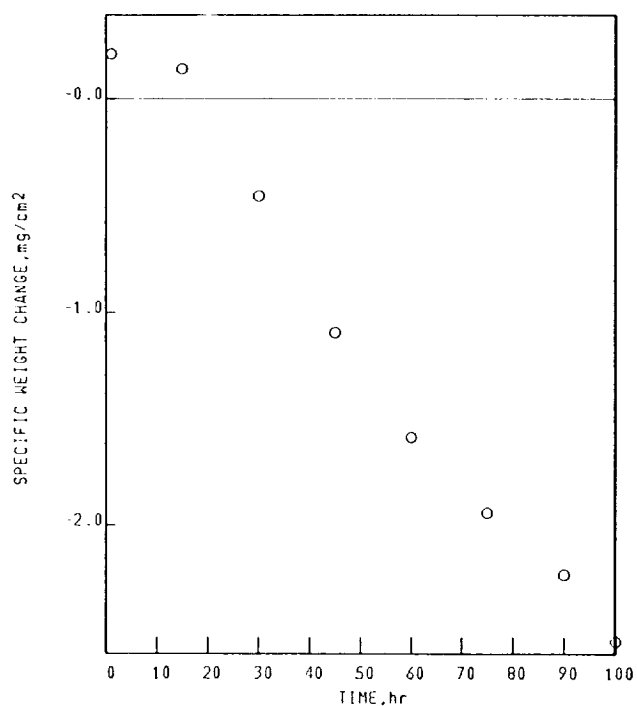
1.00hr CYCLES

100.00hr TEST

3.251mm THICK

STATIC AIR

SPECIFIC WEIGHT CHANGE DATA



TIME, hr	ΔW/A, mg/cm²
0.00	0.00
1.00	0.21
15.00	0.14
30.00	-0.46
45.00	-1.10
60.00	-1.59
75.00	-1.94
90.00	-2.23
100.00	-2.54

Co BASE

CAST (TURBINE) ALLOYS

03-02-001 098-5

X-40

1038°C

1.00hr CYCLES

100.00hr TEST

3.251mm THICK

STATIC AIR

X-RAY DIFFRACTION DATA

SURFACE

100 hr

STANDARD SURFACE

Cr₂O₃SPINEL, a₀=8.30Å.

FACE CENTERED CUBIC MATRIX

SPALL

100 hr

COLLECTED SPALL

SPINEL, a₀=8.25Å.Cr₂O₃

1. Report No. NASA TM-83665 (Rev. 1989)		2. Government Accession No.		3. Recipient's Catalog No.	
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12. Sponsoring Agency Name and Address National Aeronautics and Space Administration Washington, D.C. 20546-0001				14. Sponsoring Agency Code	
15. Supplementary Notes High-Temperature Cyclic Oxidation Data, Turbine Alloys, Part 2, by Charles A. Barrett and Carl E. Lowell, contains the remainder of the high-temperature, high-strength, nickel-base γ/γ' and cobalt-base turbine alloys tested at Lewis, and is available as NASA TM-101468.					
16. Abstract To make the large body of cyclic oxidation data collected at the NASA Lewis Research Center widely available, Lewis is publishing a series of cyclic oxidation handbooks. This first part in that series contains specific-weight-change-versus-time data and x-ray diffraction results derived from high-temperature cyclic tests on high-temperature, high-strength nickel-base γ/γ' and cobalt-base turbine alloys. Each page of data summarizes a complete test on a given alloy sample.					
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